Real Estate Opportunity Funds:
Past Fund Performance as an Indicator of Subsequent Fund Performance

by

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Submitted to the Department of Architecture in Partial Fulfillment of the Requirements for the Degree of Master of Science in Real Estate Development

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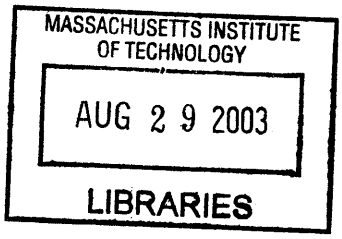

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ABSTRACT

The returns of opportunistic real estate private equity investment funds were tested for evidence of performance persistence between subsequent funds by the same manager. Tests include regression analysis, construction of contingency tables, and calculation of rank correlation coefficients. Tests were based on return data from the period 1991 to 2001 and were similar to those used to analyze performance persistence in other investment vehicles such as mutual funds and hedge funds.

Results indicate that manager performance in a given fund is a significant indicator of performance in subsequent funds, but that this persistence accounts for only a limited portion of fund return. Gross fund returns exhibit a higher degree of serial correlation than net returns. Other fund characteristics, analyzed in conjunction with previous fund performance, are not shown to be significant indicators of performance.

Thesis Supervisor: David Geltner
Title: Professor of Real Estate Finance

Acknowledgements

I am indebted to Pension Consulting Alliance, Inc. for providing the data used in this thesis. Thank you to Nori Gerardo Lietz and Denise Mouchakkaa for the time spent answering my questions, explaining data, and generally helping me to understand the industry. I would like to thank David Geltner for providing guidance, advice, and an alternate viewpoint when necessary. Thank you to Jonathan and Aidan for your patience and support. The author alone is responsible for any errors.

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Real Estate Opportunity Funds: Past Fund Performance as an Indicator of Subsequent Fund Performance

I. Introduction

This thesis investigates correlation in the performance of real estate opportunity funds. Where alpha is defined as the abnormal return of an investment, either excess or deficient return, the capital asset pricing model states that the expected value of alpha is zero and sample alphas should be unpredictable.[1] If a real estate private equity fund manager consistently outperforms or underperforms the market, then the hypothesis of market efficiency is challenged and the use of managers' track records as a selling point is validated. Because the market for real estate assets is a private market, with heterogeneous assets and asymmetrical information, it is plausible that managers could capitalize on market inefficiencies to attain a consistent alpha, which would be evidenced by correlated performance over time.

While performance persistence in other investment vehicles has been thoroughly investigated, it has not previously been studied in real estate opportunity funds. Correlation between returns of opportunity funds is investigated by the means of statistical tests. Data was provided by an investment consultancy, and covers the period 1991 to 2001, virtually the entire period that opportunistic real estate fund have existed.

While this paper begins to explore the significance of some other factors in conjunction with past performance, it focuses primarily on return history as an indicator. Factors that have been tested as possible indicators of future performance in addition to past performance include: strategy, alliance with a larger financial institution, fund size, inception year, and amount of capital raised in all funds in the fund's inception year.

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[1] Zvi Bodie, Alex Kane, and Alan Marcus, Investments, (New York: McGraw-Hill, 2002), p. 303.

II. A Brief Overview of Opportunity Funds

Real estate has traditionally been a small part of the investment portfolio. On average, for pension funds, 4%[2] of the investment portfolio is allocated to real estate, of which 30% or less is targeted to opportunistic strategies.[3] Other options for real estate investors include public securities in the form of REIT shares or CMBS, commingled funds, or separate accounts. Since opportunistic funds are perceived as high risk, similar to private equity investments such as venture capital or hedge funds, some investors consider such investment as part of a private equity portfolio rather than as a segment of their real estate holdings.[4] Estimates of value of assets controlled by real estate opportunity funds range from $100 billion[5] to $250 billion.[6]

Opportunistic real estate private equity funds are a relatively recent option for institutional and high net worth investors. They first appeared in the late 1980s and early 1990s and are only now starting to build a significant track record. Both the number of funds and the amount of capital invested are increasing. The current number of fund general partners is over 100,[7] and capital commitments to individual funds have risen from an average fund size of $293 million in vintage year 1994 to $577 million in vintage year 2000.[8] With close to $100 billion in fund equity raised through the end of 2002,[9] opportunistic real estate funds are a growing presence in real estate investments.

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[2] David Geltner and Norman Miller, Commercial Real Estate Analysis and Investments, (United States: Thomson Learning, South-Western Publishing, 2001) p. 541.
[3] Pension Consulting Alliance, "Real Estate Opportunity Funds: The Numbers Behind the Story," April 2001, p. 50.
[4] Carol Broad, Russell Real Estate Advisors, quoted by Mike Fickes, 'Feasting on Market Inefficiency Worldwide,' National Real Estate Investor, Atlanta, October, 2001.
[5] Peter Linneman and Stanley Ross, "Real Estate Private Equity Funds," white paper, Zell/Lurie Real Estate Center, 2002, p. 12.
[6] Pension Consulting Alliance, "Real Estate Opportunity Funds: Déjà vu All Over Again," May 2003, p. 5.
[7] Ernst & Young, "Opportunistic Investing: Real Estate Private Equity Funds," 2002.
[8] Based on data provided by Pension Consulting Alliance, Inc.
[9] Pension Consulting Alliance, "Real Estate Opportunity Funds: Déjà vu All Over Again," May 2003, p. 5.

Opportunistic real estate funds have taken various names over time: initially known as 'vulture funds', they are also called opportunity funds, value-added funds, and private equity real estate funds. Originally created to acquire assets from the Resolution Trust Corporation, they entered a 'repositioning' phase in early 1990s, and began to branch out to Europe in the mid 1990s.[10] Both larger investment institutions and smaller real-estate focused groups have entered the competition as sponsors, or general partners of these funds. A representative list of fund sponsors is found in Exhibit 1. However, as managers, strategies, and names have changed, one constant has been the target of achieving at least a 15 to 20% return.

Exhibit 1: Examples of Opportunity Fund Sponsors

Angelo, Gordon & Co.
Apollo Real Estate Advisors
Blackstone Real Estate Partners
Colony Capital
Credit Suisse First Boston Private Fund Group
Goldman Sachs' Whitehall Street Real Estate Funds
Heitman Financial
J.E. Robert Companies
Lehman Brothers Real Estate Partners
Lone Star
Lubert-Adler Partners
Morgan Stanley Real Estate Private Equity
Soros Real Estate Partners
Starwood Capital Group
Walton Street Capital
Westbrook Real Estate Partners
Zell/Merrill Lynch Real Estate

Typical characteristics of opportunity funds include an average expected seven year fund life, with the possibility of one or two-year extensions; alignment of investor and management interest through co-investment by the manager, a promotional interest

[10] Mike Fickes, 'Feasting on Market Inefficiency Worldwide', National Real Estate Investor, Atlanta, October, 2001.

paid as an incentive to the manager after a return hurdle has been met, and a 1-2% annual management fee. In general, opportunity funds offer managers more flexibility than separate account investment: investors commit capital to the fund and managers have discretion over which investments are made. On the other hand, opportunity funds are also less liquid investments: capital is committed for the life of the fund and an investor has no control over when monies will be returned. One result of the long life cycle of opportunistic funds is that managers have very limited track records to leverage in marketing their current funds.[11]

Funds are usually structured as limited partnerships, with the fund sponsor serving as the general partner and investors participating as limited partners. Manager and investor interests are aligned by co-investment in the fund by the general partner and incentive fees that accrue to the general partner after a hurdle rate of return is achieved.

With high return expectations, investments tend to be assets where the manager can actively increase value in a short time and then resell the asset: holding periods for typical assets tend to be two to four years.[12] The majority of return in opportunity funds comes from appreciation over a short period of time, in contrast to 'core' real estate investment, where current income is a significant factor in return. Investments are wide-ranging and include non-performing loan pools, land development, hotel companies, property conversion or redevelopment.[13] Because of the focus on high returns, managers tend to be "'traders' and 'value-enhancers' as opposed to 'operators', frequently pursuing event-driven assets."[14] In addition, to increase return, funds tend to be highly leveraged, with an average of 61% leverage.[15]

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[11] Peter Linneman and Stanley Ross, "Real Estate Private Equity Funds," white paper, Zell/Lurie Real Estate Center, 2002, p. 10-11.
[12] McGurk, John. "Opportunity Funds – Impact of Loads, Leverage and Incentive Interest," Institute for Fiduciary Education, 2002, p. 2.
[13] Ernst & Young, "Opportunistic Investing: Real Estate Private Equity Funds", 2002, p. 5.
[14] Peter Linneman and Stanley Ross, "Real Estate Private Equity Funds," white paper, Zell/Lurie Real Estate Center, 2002,, p. 8.
[15] Pension Consulting Alliance, "Real Estate Opportunity Funds: Déjà vu All Over Again," May 2003, p. 5.

The high risk/high return strategy of funds means that benchmarking performance is problematic. The NAREIT and NCREIF indexes, focusing on 'core' investment properties, have a much lower risk profile, and thus are not appropriate for comparison. In addition, they are calculated using a time-weighted return instead of the internal rate of return measure typically used to evaluate opportunity fund investment performance. Exacerbating the difficulty of measuring and comparing fund performance is the wide range of investments: land development, loan work-outs, and assisted-living projects are all examples of potential opportunity fund investments, but have very few common characteristics.[16] Finally, the absence of valuation standards[17] means that terminal values, used by fund managers to calculate interim or expected returns, may be historical cost, tax basis, or appraisal value. This results in questionable reporting consistency: interim or projected performance measures calculated by different managers may or may not be appropriate for comparison among funds.

The performance metric most generally accepted and used to measure performance of opportunity funds is the internal rate of return, or IRR.[18] The internal rate of return of an investment is the discount rate that, applied to all cash flows associated with an investment, results in a zero net present value. IRR is also recognized by the Association of Investment Management Research as being the most appropriate measure for investments such as venture capital or private equity investments.[19] Reasons that the IRR is the best measure of opportunity fund returns include the fact that the general partner controls the timing of cash flows in and out, that the calculation of a time-weighted return is distorted by the low or negative returns generated during the initial

[16] Ernst & Young, "Opportunistic Investing: Real Estate Private Equity Funds", 2002, p. 5.
[17] Peter Linneman and Stanley Ross, "Real Estate Private Equity Funds," white paper, Zell/Lurie Real Estate Center, 2002, p. 15.
[18] 98% of partners use the IRR metric according to the survey conducted by Pension Consulting Alliance, Inc., "Real Estate Opportunity Funds: The Numbers Behind the Story," April 2001, p. 43.
[19] Venture Economics website, http://www.ventureeconomics.com/vec/methodology.html#13.

asset acquisition period, and the fact that no valuation occurs at interim periods.[20] Other metrics observed include the time-weighted return and the cash multiple.

Topics currently of concern to opportunity fund managers and investors include the development of a secondary market[21] for limited partnership interests, which will increase liquidity for investors; tax issues of concern to foreign and tax-exempt investors;[22] and the necessity of establishing reporting standards. This last issue has arisen in response to criticism from investors surrounding the lack of transparency in investments, particularly joint venture deals.[23]

[20] Pension Consulting Alliance, Inc., "Real Estate Opportunity Funds: The Numbers Behind the Story", April, 2001, p. 51.
[21] Seminar, "Liquidity Through Secondary Market Transactions," Fourth Annual U.S. Real Estate Opportunity & Private Fund Investing Forum, Information Management Network, May 29, 2003.
[22] Ernst & Young, "Opportunistic Investing: Real Estate Private Equity Funds", 2002, p. 2.
[23] Sally Haskins and Joanne Douvas, presentations constituting part of "Current Issues for Investors" and presentation by Nori Gerardo Lietz at the Real Estate Opportunity and Private Fund Investing Forum, New York City, May 29, 2003.

III. Literature Review

Literature on performance persistence has focused mainly on persistence in mutual funds. As real estate opportunity funds are a relatively recent investment vehicle, it is not surprising that there have been no studies of performance persistence in these funds. Also pertinent is additional literature on correlation and persistence in investments such as hedge funds and private equity funds that have similarities to opportunity funds.

Methodologies and Survivorship Bias

Carpenter and Lynch (1999) evaluate various tests of persistence in addition to considering the effects of survivorship bias on performance persistence in mutual funds. They conclude that the t-test is best for comparing decile performance; the chi-squared test is the most robust where attrition bias exists; and the Spearman rank correlation coefficient is the most powerful test in the absence of survivorship bias. The chi-squared test and Spearman rank correlation coefficient were used in this study in addition to regression analysis, and are described below in Section V., "Methodology." Construction of portfolios based on decile performance was not possible due to the nature of the data, as also described in Section V.

Survivorship bias arises when underperforming funds are eliminated from a data set, leaving only funds that continue to exist for comparison, as opposed to a true benchmark of all funds. This bias can affect not only the apparent correlation in returns, but the returns themselves: Koh, Lee, and Fai (2001) found that with hedge funds, survivorship bias results in overall returns being overstated by 1.5-3% per year.

Brown, Goetzmann, Ibbotson, and Ross (1992), showed that the survivorship bias created by eliminating funds with the lowest total returns or lowest alpha creates apparent performance persistence, although this bias can be addressed by various measures. They

also concluded that the cross-product ratio test is not appropriate when funds drop out of the sample due to poor performance and that survivorship bias is exacerbated by volatility.

Various authors have addressed survivorship bias. Grinblatt and Titman (1992), using a benchmark constructed to avoid bias, still find evidence of persistence in mutual fund performance. Elton, Gruber, and Blake, (1996) also investigating mutual fund performance, found that even eliminating the funds most frequently ranked in the top decile of performance, risk-adjusted returns are still predictive of both short & long-run future performance.

Mutual Funds

Studies of mutual fund performance generally find evidence of serial performance correlation. Persistence is strongest in the short term and with poor performance.

Goetzmann and Ibbotson (1994) studied patterns in mutual fund return behavior over two-year, one-year, and monthly periods and found the strongest evidence of persistence in the monthly results. In addition, funds with higher volatility exhibited stronger evidence of correlated returns. Two-way contingency tables were constructed based on funds' performance as measured by returns and alphas, alpha being defined as the excess return achieved over that which would be predicted by the amount of systematic risk. The indication of correlation was verified the by regressing funds' alphas on the previous period's alpha.

Hedricks, Patel, and Zeckhauser (1993) and Malkiel (1995) also found mutual fund returns predictable and demonstrated the performance potential of an investment strategy exploiting the short-term persistence they found. Elton, Gruber, and Blake (1996) found that risk-adjusted returns are predictive of both short & long-run future performance, and used Modern Portfolio Theory to select outperforming portfolios of

funds. However, Brown and Goetzmann (1995) showed that investing in deciles of ranked fund portfolios resulted in high volatility due to a loss of diversification.

Brown and Goetzmann (1995), using contingency tables and the crossproduct ratio test, compared performance to absolute and relative benchmarks and found that persistence was due mostly to funds lagging the S&P 500. In addition, performance was correlated across managers, and was most persistent in underperforming funds.

Carhart (1997) charted factors such as expenses that explain persistence in mutual funds, concluding that only poor performance is persistent, perhaps due to illiquid stocks. Using the Spearman nonparametric test of rank ordering, he was unable to reject the null hypothesis that performance measures are randomly ordered.

Hedge Funds

The literature on hedge funds is more divided than that on mutual funds as to the existence of performance persistence: different authors have found that performance may or not be persistent, and that consistently superior strategies may or may not exist. According to Koh, Lee, and Fai (2001), hedge funds are small, leveraged, and organized around experienced investment professionals motivated with incentive fees, who often invest their own capital in partnership. Thus, they have many characteristics in common with opportunity funds.

Testing for performance by regressing current returns on past returns, Brown, Goetzmann, and Ibbotson (1998) found no evidence of performance persistence in hedge funds, also concluding that fund size was unrelated to performance. Kat and Menexe, (2002) using contingency tables and regression analysis, found persistence in standard deviation and correlation with the market but little persistence in hedge fund returns. They suggest that performance measurements may gauge persistence of style rather than

superior returns, recommending that returns are more useful to compare relative risk among funds with similar strategies than as a predictor of the fund's risk profile.

In contrast, Agarwal and Naik (2001) found performance persistence at a quarterly level that was unrelated to strategy. Bares, Gibson and Gyger, (2002) testing for performance persistence using portfolios constructed on return and risk-adjusted return, also found evidence of performance persistence among hedge funds over short-term holding periods. They also concluded that some strategies consistently outperform others.

In a working paper on hedge funds, Getmansky, Lo, and Makarov (2003) found that serial correlation in returns was most likely due to illiquidity of assets and non-synchronous trading, and may also be the result of varying expected returns, varying leverage, and fund compensation structure.

Other Investments

Private equity funds are described by Ljungqvist and Richardson (2003) as having a long illiquid initial period of several years of negative returns, as being affected by the drawdown timing, and as being limited by self-reporting and the unknown risk to investors in the underlying assets. These are all characteristics that make such vehicles similar to real estate opportunity funds. Their study does not include an analysis of fund performance persistence, but does find that fund size and the amount of capital committed in all funds in the inception year of a fund are correlated to fund performance.

IV. Data

Data used in this study was provided by Pension Consulting Alliance, Inc, a consultancy organization which in addition to providing advisory services for pension funds, conducts research and reporting on investment topics.[24] Data was gathered from fund general partners by questionnaires and interviews for reports in 2001 and 2003. 55 firms representing over 187 partnerships during the period 1988 to 2000 participated in the initial survey. This was approximately 90% of current firms, based on the number of firms rather than the amount of capital.[25] The second survey collected information from 51 firms and over 255 funds.[26] Manager and fund identity were masked to preserve confidentiality.

The data set consists of 43 managers with 110 funds started between 1991 and 2001. Eight of the 51 firms were eliminated from the data set, primarily because confidentiality agreements prevented them from providing information. The eliminated firms did not share common characteristics such as size, location, or clientele.[27] Of these 43 remaining managers, 24 had more than one fund. Information on the underlying investments in some of the funds was provided by some managers. One limitation of the data is that very few of the funds have fully liquidated. Returns for the remaining funds are based on interim returns and expected return and terminal values calculated by the managers.

Internal rates of return in the database are based on the managers' valuation of the residual assets remaining in the funds as of the end of the data history in 2001. Although investors have noted inconsistency in reporting and measurements among opportunity

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[24] Pension Consulting Alliance website: http://www.pensionconsulting.com.
[25] Pension Consulting Alliance, "Real Estate Opportunity Funds: The Numbers Behind the Story," April 2001, p. 2.
[26] Pension Consulting Alliance, "Real Estate Opportunity Funds: Déjà vu All Over Again," May 2003, p. 3.
[27] Email correspondence with Denise Mouchakkaa, Pension Consulting Alliance, July, 2003.

fund managers,[28] Pension Consulting Alliance investigated and confirmed return calculations where possible, using cash flow information provided by both general partners and investors.[29] Thus, although terminal valuations remain dependent upon managers' valuation methodology, the data reflects the highest level of consistency possible.

Opportunistic real estate private equity funds are less liquid than mutual funds: with no continuous exchange mechanism such as a stock market, it is impossible to calculate a daily, weekly, or annual return based on daily trading or NAV. With no market valuation for the fund during its life, a single IRR is calculated for the life of fund based on contributions and distributions. Thus, although some of the tests employed are similar to those used in the literature surveyed, only one return data point exists for each fund, rather than the many data points that can be used to calculate a series of time-weighted returns for a single mutual fund based on its trading history.

The extent to which attrition bias exists in the sample is unclear. While some firms included in the earlier survey were not included in the later survey, not all of this attrition was due to poor performance of their funds. However, if the reduction from 55 managers in 2000 survey to 51 managers in the 2002 survey were indicative of fund attrition, it suggests that about 4% of managers are eliminated each year. For mutual funds, Brown Goetzmann, Ibbotson, and Ross find this degree of attrition corresponds to an return effect of about .4% annually.[30]

Another potential issue that could be raised with the data lies with the wide variation in the definition of opportunity fund: some managers included in the survey define their funds as value-added or core-plus rather than as opportunity. Pension

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[28] Pension Consulting Alliance, "Real Estate Opportunity Funds: The Numbers Behind the Story," page 59, and Sally Haskins, Russell Real Estate Advisors, 'Perspectives on Reporting', presented May 29, 2003 at the Real Estate Opportunity and Private Fund Investing Forum, New York City.
[29] Email correspondence with Denise Mouchakkaa, Pension Consulting Alliance, July, 2003.
[30] Brown, Goetzmann, Ibbotson, Ross, "Survivorship Bias in Performance Studies." The Review of Financial Studies Volume 5, no. 4, 1992, p. 568.

Consulting Alliance considered target returns, leverage, and investment returns in including a fund in the survey:[31] funds targeting 18% or higher gross returns and using at least 50% leverage were defined as opportunity funds. The difficulty in defining the realm of opportunity funds is illustrated by the difference in estimates of funds and capital raised: Ernst & Young estimated that by 2000, $55.27 billion had been raised by 122 funds[32], compared while Pension Consulting Alliance calculated $71.37 billion (revised in 2003 to $77.05 billion) raised by 187 funds.[33]

A manager is considered to be the sponsoring firm rather than the individual corporate officers. Although individuals may have different management styles, abilities, and connections to deal sources, this was not tracked in the data set. Considering the short time period, it may be reasonable to expect that the primary participants stayed the same over the ten year period for most firms, but future studies may want to consider individual manager involvement as well as corporate management.

The data characteristics have been well described in Pension Consulting Alliance's two reports: a summary of fund returns and size follows.

It is interesting to note that of all the funds included in the database, only 48, or 44% of the 110 funds, achieved net returns exceeding 15%. Only 28, or 25% of the funds, achieved net returns exceeding 20%. Funds from the 1991 – 1997 cohorts were more successful in reaching their targeted return: 28, or 61% of the 46 funds from the period, achieved a net IRR in excess of 15%. 15 funds, or 33%, returned in excess of 20% net.

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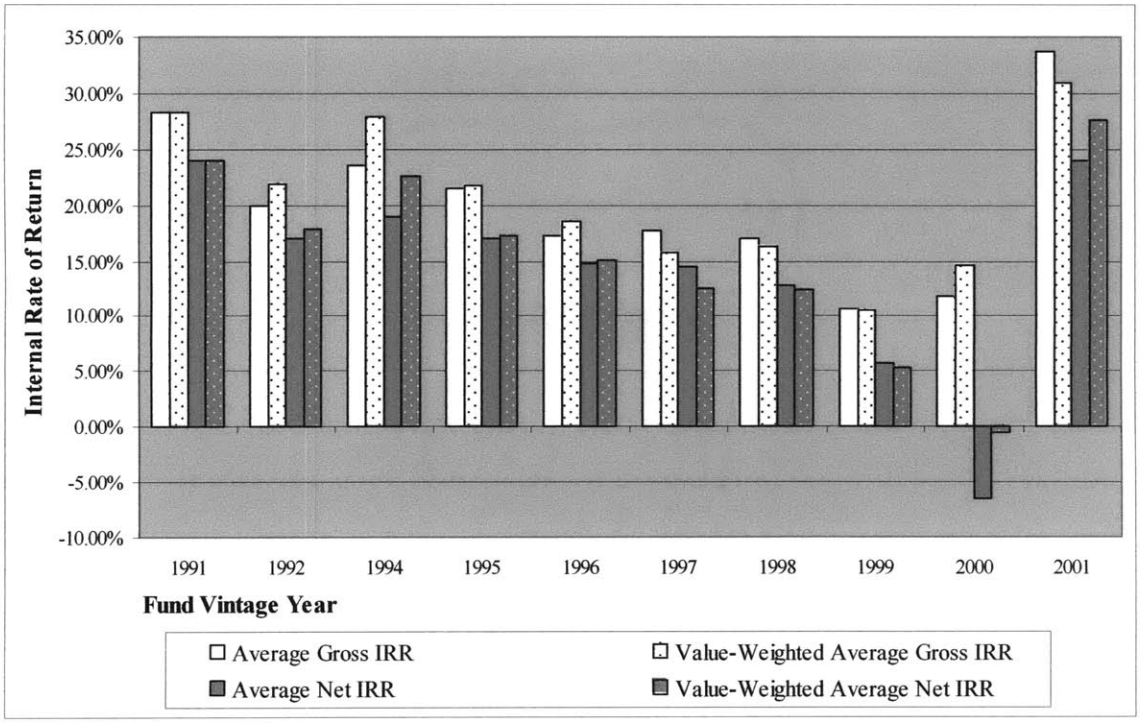
[31] Email correspondence with Denise Mouchakkaa, Pension Consulting Alliance, July, 2003
[32] Ernst & Young, "Opportunistic Investing: Real Estate Private Equity Funds", 2002, p. 1.
[33] Pension Consulting Alliance, "Real Estate Opportunity Funds: The Numbers Behind the Story", April 2001, p.6, revised in "Real Estate Opportunity Funds: Déjà vu All Over Again", May 2003, p. 5.

Exhibit 2: Summary Information on Fund Returns

Vintage Year	Value-Weighted Arithmetic Average		Arithmetic Average	
	Gross	Net	Gross	Net
1991	28.30%	24.03%	28.30%	24.03%
1992	21.87%	17.89%	20.02%	16.97%
1994	27.90%	22.64%	23.53%	18.96%
1995	21.72%	17.26%	21.42%	17.06%
1996	18.56%	15.14%	17.30%	14.74%
1997	15.82%	12.61%	17.66%	14.51%
1998	16.27%	12.49%	16.99%	12.84%
1999 [1]	10.45%	5.33%	10.59%	5.76%
2000	14.72%	-0.56%	11.87%	-6.53%
2001	30.95%	27.57%	33.77%	24.02%
Averages	20.66%	15.44%	20.15%	14.24%

[1] return numbers exclude those of one fund with reported gross IRR over 2000%.

Exhibit 3: Returns to Opportunity Funds 1991 – 2001



Histograms constructed of the opportunity fund returns indicated that returns are approximately normally distributed: this is important because it implies that Koh, Lee, and Fai's finding (2001) demonstrated that the leptokurtic, or fat-tailed, distribution of hedge fund returns reduces their diversification benefits does not apply to real estate opportunity funds.

Exhibit 4: Summary Information on Fund Size

Vintage Year	Average Fund Size	Median Fund Size	Total Funds Raised ($Million)	Number of Funds
1991			150	1
1992	477	477	953	2
1994	293	200	2,641	9
1995	267	182	2,671	10
1996	421	275	6,313	15
1997	413	260	3,719	9
1998	515	412	13,399	26
1999	549	502	9,596	17
2000	577	345	6,928	12
2001	396	320	3,169	8
Averages	434	330	4,954	11

V. Methodology

Various tests, have been used to analyze persistence in mutual funds, hedge funds, and venture capital funds. Parametric tests are those used with data which has a known distribution, defined by parameters such as mean and variance. Nonparametric methods are those that can be used with data that is ordinal, or whose distribution is unknown.[34] In both cases the tests attempt to disprove a null hypothesis about relationships that may or may not exist in the studied data. In this case, both parametric and nonparametric tests were used to test the null hypothesis that no relationship exists between the performance of a manager's past funds and a manager's later funds. Parametric tests consisted of regressing fund performance on past fund performance and other independent variables. Nonparametric tests included constructing and analyzing contingency tables, and calculating and analyzing the Spearman rank correlation coefficient and the Kendall coefficient. All tests were performed using the data analysis software in Microsoft Excel 2002.

An additional test frequently seen in the literature is the creation of an investment strategy based on historical evidence of persistence and the analysis of the strategy's simulated performance had it been employed over historical periods of time. Due to the lack of multiple return measurements and the short period of time captured by the data, creating an investment strategy and testing its performance over historical periods of time was not possible.

Tests were performed using the entire database and then repeated using only funds originated in the years 1991 to 1997. Since funds established prior to 1997 might be expected to have completed or be reaching the end of their life cycle, and thus have more definite return numbers, it might be argued that conclusions drawn from this

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[34] P. Sprent and N.C. Smeeton, Applied Nonparametric Statistical Methods, 3rd edition (New York: Chapman & Hall/CRC, 2001), p.3.

reiteration could be more reliable. However, it should be noted that further restricting the already limited size of the data set results in a very small sample size.

To permit comparison of fund performance across different vintage years, fund performance was ranked and subsequently normalized. Fund performance was evaluated based on normalized ranking rather than absolute performance or performance relative to a benchmark. For each group of funds with a common year of inception, each individual fund was ranked from 1 for highest to n for the lowest-performing fund based on the calculated IRR. Then, a normalized ranking (NR) with a value from 1 to 0 inclusive was calculated using:

$$NR = (n - r)/(n - 1)$$

where n = number of funds in the vintage year and r = absolute rank of the fund. Both rank and normalized rank were calculated based on both net and gross IRR for each fund, and tests were performed with both net and gross rankings. In vintage year 1991, only one fund exists in the data set: it was assigned a normalized rank of 0.5.

The first nonparametric test is the construction of contingency tables, following the methodology of Brown and Goetzmann (1995). This test has been used in many past studies of performance persistence, and was selected in part because the chi-squared test which is based on it was found by Carpenter and Lynch (1999) to be a strong test of performance persistence even in the presence of any attribution bias. Pairs of funds are identified from sequential funds: for example, with one manager's funds A, B, and C in three subsequent years, two pairs are established (A-B and B-C). Then, the pairs of funds are sorted into a matrix depending on their rankings: win/win, win/lose, lose/win, lose/lose. 'Win' is defined as a ranking in the top half (NR > 0.5), third (NR > 0.66), or quartile (NR > 0.75).[35] The matrix generated is then compared to the frequency that would be expected if fund performance were independent of previous fund performance.

[35] In the few cases where a manager had more than one fund in a vintage year, the first variable for the next pair is defined as a win or lose by an average of the rankings for the preceding year funds.

The chi-squared test is then used to determine if the deviation from the expected distribution is statistically significant.

Another indicator of statistical significance generated using the contingency table is the cross-product ratio test. Used by Brown and Goetzmann (1995), the cross-product ratio is obtained by dividing the product of the win/win and lose/lose cells by the product of the win/lose and lose/win cells. [(WWxLL)/(WLxLW)] In the case of no performance correlation, the expected ratio is one. The ratio can be tested statistically by calculating a z-statistic = $\ln(CPR)/ \delta_{\ln(CPR)}$,[36] where the standard error of the natural log of the cross product ratio, $\delta_{\ln(CPR)} = \sqrt{(1/WW + 1/WL + 1/LW + 1/LL)}$.

Additional tests for correlation or dependence between two variables are the Spearman rank correlation coefficient, or rho, and the Kendall correlation coefficient, or tau. Pairs of funds are identified, as with the contingency tables, and the ranks of each pair are compared. These measures test whether there is a correlation in trend:[37] if ranking of a subsequent fund increases (decreases) as the ranking of the earlier fund increases (decreases). The null hypothesis being tested is that the first and second rankings of each pair are unrelated. Both coefficients will have values between -1 and 1: a value near zero indicates a lack of association.

The Spearman rank correlation coefficient was identified by Carpenter and Lynch (1999) as being a strong test for persistence in the absence of attrition bias. The formula for Spearman's rho is:

$$r_s = 1 - 6T/n(n^2-1)$$

[36] Harry Kat and Faye Menexe, "Persistence in Hedge Fund Performance: The True Value of a Track Record," Alternative Investment Research Centre Working Paper Series, Working Paper #0007, 2002.
[37] P. Sprent and N.C. Smeeton, Applied Nonparametric Statistical Methods, 3rd edition, p. 243.

where $T = \sum_i (r_i - s_i)^2$, with (r_i, s_i) indicating the ranks of each pair[38]. The null hypothesis of no association between the paired variables is then tested based on a t-statistic calculated using $t = r_s\sqrt{(n-2)}/\sqrt{(1-r_s^2)}$ with d.f. = n – 2.[39]

Kendall's tau is similar to Spearman's rho, but has been described as having a more intuitive and simple interpretation.[40] In addition, there is a simple variation to allow for adjustment due to ties in ranks. Again, pairs of variables are identified – in this study, fund ranking and subsequent fund ranking. The first member of each set is called the x-rank, and the second the y-rank. The pairs are arranged with the x-ranks in ascending order and then the differences between consecutive y-ranks are scored as a concordance if the difference is positive and a discordance if negative. The number of concordances (n_c) and discordances (n_d) are then used to calculate Kendall's tau,

$$t_k = (n_c - n_d)/\{(1/2)n(n-1)\}$$

The basis of Kendall's tau is that if the ranks of x and y are associated, then if the x-ranks are arranged in ascending order the y-ranks should be increasing if there is positive association and decreasing if there is negative association.[41] Tau_b, a variation, reflects an adjustment in the formula to account for ties in rank and is calculated,

$$t_b = 2(n_c - n_d)/\sqrt{(n^2 - n - 2t')}\ \sqrt{(n^2-n-2u')}$$

with $t' = (\sum t2 - \sum t)/2$ where t is equal to the number of tied observations at any given value in the x-ranks and u' is the same calculation for the y-ranks.[42] The resulting coefficient is then converted into a t-statistic using the equation[43]

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[38] P. Sprent and N.C. Smeeton, Applied Nonparametric Statistical Methods, 3rd edition, p. 243.
[39] http://www.stats.ox.ac.uk/~marchini/teaching/booklets/fb.pdf, online resource from Oxford University, p. 8-10.
[40] Jean Dickinson Gibbons, Nonparametric Measures of Association,, Sage University Papers, Quantitative Applications in the Social Sciences, vol. 91. (Newbury Park, California: Sage Publications, Inc., 1993), p. 20.
[41] P. Sprent and N.C. Smeeton, Applied Nonparametric Statistical Methods, 3rd edition, p. 247.
[42] Jean Dickinson Gibbons, Nonparametric Measures of Association,, Sage University Papers, Quantitative Applications in the Social Sciences, vol. 91. (Newbury Park, California: Sage Publications, Inc., 1993), p. 15.

$$\text{t-statistic} = 3t_k\{\sqrt{[n(n-1)]} / \sqrt{[2\,(2n+5)]}\}$$

where n = number of paired ranks. This t-statistic is then used to evaluate the probability of obtaining the given coefficient in the case that the null hypothesis were true.

In addition to the nonparametric tests conducted, regression analyses were also performed. Because, as noted earlier, there is only one performance measure for each fund, the analysis tests for a relationship between the performance of a fund and that of subsequent fund with the same manager. This is in contrast to the literature surrounding mutual funds, which tests for a relationship with subsequent performance of the same fund.

The initial test is to regress the ranking of a fund onto the existence of a previous fund. A dummy variable is set equal to one if the manager has had a previous fund, zero if the manager has no previous fund. The formula being estimated in this case takes the form:

$$NR = \alpha + \beta EF$$

with NR signifying the fund's normalized rank and EF representing a dummy variable for the existence of an earlier fund. There are two plausible expectations for the results: the first, that managers benefit from previous experience and therefore that performance will improve in subsequent funds. The second possible expectation is that managers of funds who outperform peers get another chance, but then are unlikely to outperform again. In the first case, a positive coefficient on the independent variable would be expected; in the second case, a negative coefficient.

Later analyses regress the performance of a fund onto the performance of one or more earlier funds by the same manager, the performance of a manager's fund exactly or

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[43] Peter Chen and Paula Popovich, Correlation: Parametric and Nonparametric Measures, Sage University Papers, Quantitative Applications in the Social Sciences, vol. 139. (Thousand Oaks, California: Sage Publications, Inc., 2002), p. 84.

more than five years earlier, or the average performance of all the manager's previous funds. The formula being estimated takes the form:

$$NR = \alpha + \beta LR \ (+ \delta LLR)$$

where NR again signifies the fund's normalized rank, LR represents the lagged rank from the appropriate prior fund, and LLR represents the rank of an additional previous fund. In all cases, if past performance is positively correlated with future performance, a positive-signed coefficient on the independent variable or variables would be expected.

Additional regressions test past performance in combination with geographical focus, product focus, leverage ratio, size of fund, amount of funds raised in a vintage year, and parent company focus. Information on fund assets and strategies was not available for all the managers, so the sample size for these regressions was small. The formula being estimated takes the form:

$$NR = \alpha + \beta LR \ + \delta DF$$

where NR again signifies the fund's normalized rank, LR represents the lagged rank from the appropriate prior fund, and DF represents the descriptive feature such as focus or size of the fund. Again, if any of these factors has a positive relationship with fund performance, a positively-signed coefficient on the independent variable would be expected.

VI. Results and Analysis

Before commencing statistical analysis of the fund performance data, fund return and rankings were analyzed graphically. Charting chronological performance of managers' funds with ranking on the x-axis and fund number on the y-axis gave no clear indication of any consistent patterns. The series was approximately equally divided between rising, falling, u-shaped, and bell-shaped graphs, with only one graph taking a 'flat' shape that would most correspond to performance persistence. Interestingly, only four managers show identical rankings based on both gross and net IRRs. Chronological charts of all 24 managers with multiple funds are included in the Appendix, as are full regression analysis outputs.

Contingency Tables

Contingency tables were constructed using pairs of funds from managers with more than one fund. Using all funds resulted in 68 pairs, while restricting the funds to those started between 1991 and 1997 resulted in 23 pairs. The first matrices divided funds into win/win, win/lose, lose/win, and lose/lose quadrants based on above- or below-median performance. The null hypothesis is that the first ranking and second ranking are unrelated, giving an expected frequency in each cell of the matrix of one-quarter of the total number of pairs. The expected and actual frequencies are shown below.

Exhibit 5: Contingency Tables: 'Win' Equal to Above-Median Performance

Division by Median - All Fund Years

Observed Frequencies

GROSS

	W	L
W	19	11
L	12	26

NET

	W	L
W	20	10
L	12	26

Expected Frequencies

	W	L
W	17.00	17.00
L	17.00	17.00

Chi-squared: Gross 0.003383
Net 0.001897

Division by Median - 1991 - 1997

Observed Frequencies

GROSS

	W	L
W	6	3
L	4	10

NET

	W	L
W	6	3
L	4	10

Expected Frequencies

	W	L
W	5.75	5.75
L	5.75	5.75

Chi-squared: Gross 0.025347
Net 0.025347

The chi-squared statistic for all years based on gross IRR was 0.0034; based on net IRR it was 0.0019. This indicates a less than 1% chance of obtaining the distribution seen if the rankings were in fact independent: the null hypothesis of no correlation in fund returns can therefore be rejected with 99% confidence. For the period 1991 to 1997 based on both gross and net IRR the null hypothesis can be rejected with 97% confidence.

Contingency tables were also constructed using the average performance ranking of all previous funds in lieu of the immediately preceding fund. Funds were defined as 'win' or 'lose' based whether their ranking was above or below a median normalized ranking of 0.5. The expected and actual frequencies are shown in Exhibit 6.

Exhibit 6: Contingency Tables: 'Win' Equals Above-Median Average Performance

Average Prior Ranking - All Years

Observed Frequencies

GROSS

	W	L
W	19	16
L	12	21

NET

	W	L
W	21	16
L	11	20

Expected Frequencies

	W	L
W	17.00	17.00
L	17.00	17.00

Chi-squared: Gross 0.099979
Net 0.056168

Average Prior Ranking - 1991-1997

Observed Frequencies

GROSS

	W	L
W	5	5
L	5	10

NET

	W	L
W	5	5
L	5	10

Expected Frequencies

	W	L
W	6.25	6.25
L	6.25	6.25

Chi-squared: Gross 0.083265
Net 0.083265

The chi-squared statistic for all years based on gross IRR was 0.099; based on net IRR it was 0.056. This indicates that the no-relationship null hypothesis can be rejected with 90% confidence in the case of the gross IRR and 94% confidence based on the net IRR. Based on the chi-squared statistics from the period 1991 to 1997, the null hypothesis can be rejected at the 92% confidence level.

Additional tables were constructed defining a 'win' as a ranking in the top third or quartile of funds. Again, expected frequencies were determined using the null hypothesis that sequential rankings are unrelated: rankings for any given period would be equally likely to be in each third or quartile. It should be noted that grouping all rankings below the top quartile into the 'lose' category increased the frequency expected in each cell of the matrix, but still resulted in an expected frequency of only 4 in the W-W cell of the quartile table. Since an expected frequency of at least 5 for each cell of the contingency table is necessary for a valid test,[44] the power of this particular analysis can be questioned. The observed and expected frequencies are shown below.

[44] Koosis, Statistics: A Self-Teaching Guide, 4th edition (New York: John Wiley & Sons, 1997), p. 220.

Exhibit 7: Contingency Tables: 'Win' Equal to Top-Quartile or Third Performance

Division by Quartile

Observed Frequencies

GROSS

	W	L
W	7	6
L	8	47

NET

	W	L
W	6	9
L	10	43

Expected Frequencies

	W	L
W	4.25	12.75
L	12.75	38.25

Chi-squared: Gross 0.002523
Net 0.082929

Division by Thirds

Observed Frequencies

GROSS

	W	L
W	9	11
L	12	36

NET

	W	L
W	8	13
L	12	35

Expected Frequencies

	W	L
W	7.56	15.11
L	15.11	30.22

Chi-squared: Gross 0.076408
Net 0.190091

The deviation from the expected frequency is most strongly statistically significant in the matrix based on quartile gross IRR performance. The null hypothesis of no correlation can be rejected at a 99% confidence level based on gross IRR rankings and at a 92% confidence level based on net IRR. For the matrix based on thirds performance, the chi-squared statistic based on gross IRRs indicate rejection of the no-persistence null hypothesis at 94% confidence, while based on net IRR it can be rejected at no more than 81% confidence.

Finally, contingency tables were constructed using normalized ranks of funds separated by at least 5 years. This limitation resulted in only 13 observations, so the expected frequencies were below the 5 per cell necessary to perform a robust test, but it is interesting to note that observed frequencies in the matrix constructed with average IRRs are weighted toward the win-win and win-lose cells. This distribution suggests that only 'winning' managers are afforded the opportunity for additional funds.

Exhibit 8: Contingency Tables: 'Win' Based on 5-Year Lagged Performance

Five-Year Lag

Observed Frequencies

GROSS

	W	L
W	0	6
L	5	2

NET

	W	L
W	1	5
L	4	3

Expected Frequencies

	W	L
W	3.25	3.25
L	3.25	3.25

Chi-squared: Gross 0.008151
Net 0.100834

Five-Year Lagged Average

Observed Frequencies

GROSS

	W	L
W	3	6
L	2	2

NET

	W	L
W	4	5
L	1	3

Expected Frequencies

	W	L
W	3.25	3.25
L	3.25	3.25

Chi-squared: Gross 0.068956
Net 0.100834

An interesting issue that arises in the analysis of these tables is the apparent differing strength of persistence between ranking results based on gross IRRs and those based on net IRRs in some of the tables. One possible explanation might be management fee structure: distributing a large proportion of excess returns or a small proportion of lower than expected returns could affect a fund's net IRR ranking. McGurk illustrates the different impacts a prorated split or catch-up provision has on fund yield:[45] it might be illuminating to consider the difference in performance in light of additional information on fee terms.

[45] John McGurk, "Opportunity Funds – Impact of Loads, Leverage and Incentive Interest," Institute for Fiduciary Education, 2002, p .3.

Exhibit 9: Contingency Tables: Summary of Chi-Squared Statistics

Table		Chi-Squared
Median	GROSS	0.003383
	NET	0.001897
Median 91-97	GROSS	0.025347
	NET	0.025347
Third	GROSS	0.076408
	NET	0.190091
Quartile	GROSS	0.002523
	NET	0.082929
Average	GROSS	0.007526
	NET	0.006627
Av. 91-97	GROSS	0.124482
	NET	0.124482

Calculating cross-product ratios per Brown and Goetzmann (1995), the results are generally consistent with the chi-squared statistics obtained from the contingency tables. The null hypothesis of no correlation can be rejected in 9 cases at a 90% confidence level or higher. The weakest indicators of correlation are based on average returns in the 1991-1997 period and on net performance in the matrix constructed using top-third performance as the criterion.

Exhibit 10: Contingency Tables: Cross-Product Ratios

Table		Ratio	$\delta_{ln(CPR)}$	log-odds	Z-stat	Significance
Median	GROSS	3.74	0.515	1.320	2.562	0.5%
	NET	4.33	0.521	1.466	2.813	0.2%
Median 91-97	GROSS	5.00	0.922	1.609	1.746	4%
	NET	5.00	0.922	1.609	1.746	4%
Third	GROSS	2.45	0.560	0.898	1.605	5%
	NET	1.79	0.560	0.585	1.044	15%
Quartile	GROSS	6.85	0.675	1.925	2.851	0.2%
	NET	2.87	0.633	1.053	1.663	5%
Average	GROSS	2.08	0.496	0.731	1.475	7%
	NET	2.39	0.501	0.870	1.736	4%
Av. 91-97	GROSS	2.00	0.837	0.693	0.828	20%
	NET	2.00	0.837	0.693	0.828	20%

In summary, the contingency tables indicate strong performance persistence based upon division by above or below-median performance. Above-average performance based on average past ranking, top quartile, or top third ranking is also persistent, although weakly in the case of average past rankings over the period 1991 - 1997.

Rank Correlation Statistics

The next series of tests look at correlation in rank from one fund to the next. For both the Spearman statistic and Kendall's tau, a value of 1 indicates that the first variable and second variable are perfectly correlated, a value of -1 indicates the variables are perfectly negatively correlated, and a value of 0 indicates no correlation between the variables. The null hypothesis in all cases is that there is no association between the two variables, with the alternative hypothesis being that there is association between them.

The first Spearman rank statistic was calculated using the normalized rank of a managers' fund as the first variable and the normalized rank of the manager's next fund as the second variable. With 68 pairs of variables, the calculated coefficients of 0.465 (based on gross IRR rankings) and 0.413 (based on net IRR rankings) indicate a strong correlation between rankings: the null hypothesis of no persistence can be rejected at a 99% confidence level. The positively-signed coefficients suggest an alternate hypothesis of positive correlation between performance of a manager's funds. Additional coefficients were calculated limiting the data set to funds in the 1991 – 1997 period. Again, the results were highly significant and the null hypothesis can be rejected at the 99% confidence level.

The Spearman rank statistic was then calculated using the average normalized rank of all of a manager's previous funds as the first variable and the normalized rank of the manager's next fund as the second variable. The calculated coefficients of 0.310 (based on gross IRR rankings) and 0.256 (based on net IRR rankings) again indicate a

strong correlation between rankings: the null hypothesis of no persistence can be rejected at a 99% confidence level. Limiting the data set to funds in the 1991 – 1997 period, the null hypothesis can be rejected at a 99% confidence level based on gross IRR and at a 95% confidence level based on net IRR.

Additional coefficients were calculated using funds that had another fund by the same manager with at least a five year lag, resulting in 13 pairs of variables. The first variable was the rank of the fund most immediately preceding the later fund with the four-year intervening period, or the average of the ranks of funds by the same manager that were at least four years previous to the fund ranked in the second variable. In both cases the second variable was the rank of the later fund. Coefficients generated were in the range of -0.651 to -0.330. These statistics are not significant at a 10% level of confidence: the null hypothesis of no correlation cannot be disproved in this case.

Exhibit 11: Summary of Spearman Rank Correlation Coefficients

Pairing Series		Pairs	r_s	t - statistic	Significance
Past	GROSS	68	0.4649	7.1129	0.00%
	NET	68	0.4130	5.7592	0.00%
Past 91-97	GROSS	23	0.5267	5.2192	0.00%
	NET	23	0.4447	3.7557	0.12%
Average	GROSS	68	0.3101	3.6796	0.05%
	NET	68	0.2560	2.8159	0.64%
Average 91-97	GROSS	25	0.3690	2.8653	0.87%
	NET	25	0.2996	2.0957	4.73%
5 Yr Lag	GROSS	13	-0.6511	-1.3660	19.92%
	NET	13	-0.4739	-1.1138	28.91%
5 Yr Lag Average	GROSS	13	-0.5165	-1.1798	26.30%
	NET	13	-0.3297	-0.8589	40.87%

As with the contingency tables, the Spearman rank correlation statistics generated from the larger data set allow the rejection of the null hypothesis of no persistence at a high level of confidence, strongly indicating performance correlation. However, statistics

generated using five-year lagged rankings do not allow rejection of the null hypothesis of no relationship between rankings.

The last statistical test of rank correlation considered was Kendall's tau. As with earlier tests, the coefficient was calculated using both the entire data set and subsequently using a data set limited to the period 1991 – 1997. Results are as shown below.

Exhibit 12: Summary of Kendall's tau

Pairings		t_k	t-statistic	t_b	t-statistic	Significance
All	**GROSS**	0.2381	2.9151	0.2448	2.9972	0.38%
	NET	0.2087	2.5551	0.2112	2.5862	1%
1991 - 1997	**GROSS**	0.1167	0.8174	0.1193	0.8355	41%
	NET	0.1067	0.7474	0.1098	0.7692	45%

The results from the entire data set are strongly significant, and the null hypothesis of no correlation between rankings can be rejected with 99% confidence, while the coefficients based on the smaller data set are not statistically significant and do not support the rejection of the null hypothesis. These results are consistent with those based on the Spearman rank correlation coefficient and on the contingency tables.

Regression Analyses

The possible effect of manager experience was analyzed first by regressing the ranking of a manager's fund on the existence of a previous fund by the same manager. The null hypothesis is that the existence of a prior fund is unrelated to the performance of a fund. Although in all cases the results are not statistically significant and the null hypothesis cannot be rejected, it is interesting to note that the coefficients on the variable representing the existence of a previous fund are consistently negative. The implied negative correlation suggests that managers of funds who outperform peers are able to raise a subsequent fund, but then are unlikely to outperform again.

Exhibit 13: Regression of Fund Performance on Existence of Previous Fund

	All Years		1991-1997	
	Gross	Net	Gross	Net
Adjusted R2	-0.0027	-0.0049	-0.0185	-0.0207
EF Coefficient	-0.0482	-0.0395	-0.0379	-0.0261
t-statistic	-0.8431	-0.6879	-0.4291	-0.2955
P-value	0.4010	0.4930	0.6700	0.7690
Intercept	0.5748	0.5699	0.5833	0.5783
t-statistic	12.8839	12.6105	9.5548	9.2621
P-value	0.0000	0.0000	0.0000	0.0000

Persistence was next analyzed by regressing a fund's ranking on the manager's previous fund ranking, testing the null hypothesis that return on a manager's fund is independent from return on the same manager's previous fund. The results based on the entire data set are strongly statistically significant: the null hypothesis can be rejected with 99% confidence in favor of the alternate hypothesis that a relationship exists between fund return and return on the previous fund by the same manager. Limiting funds to those in vintage years 1991 – 1997, the null hypothesis of no persistence can be rejected with 99% confidence based on gross IRR rankings and with 95% confidence based on net IRR rankings. The adjusted R-squared statistics indicate that as much as

24% of a fund's performance ranking is related to the performance of its manager's previous fund.

Exhibit 14: Regression of Ranking on Previous Ranking

	All Years		1991-1997	
	Gross	**Net**	**Gross**	**Net**
Adjusted R2	0.2045	0.1458	0.2441	0.1435
LR Coefficient	**0.4939**	**0.4145**	**0.5296**	**0.4055**
t-statistic	4.2686	3.5260	2.8469	2.1650
P-value	0.0001	0.0008	0.0097	0.0420
Intercept	0.2462	0.2799	0.2383	0.2932
t-statistic	3.7502	4.0912	2.2443	2.6743
P-value	0.0004	0.0001	0.0357	0.0142

In all cases, the relationship between consecutive funds' performances is stronger based on gross IRR than when analyzed using net IRR rankings. One possible explanation for this could be the variation in performance incentives and fee structure among funds: abnormal gross return may be absorbed by fees. Over the period 1991 – 1997, the average difference between the funds' gross IRR and net IRR was 3.52%, or 19.42% of the total gross IRR. For the same period, the absolute difference between gross and net IRR ranged between 0.57% and 14.08%, while the proportional change varied from 5.64% to 96.13% of return.

A variation of the above regression was then performed using as the independent variable the average ranking of all funds by the same manager previous to the selected fund. The null hypothesis is that fund performance is independent from the average of the manager's previous fund returns. Results are consistent with but slightly weaker than those of the regression onto previous fund performance. Using the full data set, the null hypothesis can be rejected with a 99% level of confidence for the gross IRR rankings and a 90% level of confidence for the net IRR rankings. The adjusted R-squared statistic indicates that as much as 9% of fund performance is related to average previous fund performance. When the data is limited to the years 1991-1997, the null hypothesis can be rejected at a 90% level of confidence based on the gross IRR rankings, but cannot be

rejected based on the net IRR rankings. Again, statistics indicate a weaker relationship between previous and future fund performance based on net IRR measures.

Exhibit 15: Regression of Ranking on Average of Previous Rankings

	All Years		1991-1997	
	Gross	**Net**	**Gross**	**Net**
Adjusted R2	0.0869	0.0385	0.0912	0.0148
AR Coefficient	**0.3835**	0.2805	0.3733	0.2420
t-statistic	2.7162	1.9185	1.8459	1.1661
P-value	0.0084	0.0594	0.0778	0.2555
Intercept	0.2967	0.3467	0.3084	0.3664
t-statistic	3.7535	4.1937	2.9026	3.3207
P-value	0.0004	0.0001	0.0080	0.0030

From a practical point of view, it is unlikely that fund performance will be clearly above or below average after only one year. In light of the fact that fund performance may not be known until several years after inception, additional regression analyses were performed using fund pairs with at least a five year lag between inception years. In the first case, the independent variable was the ranking of the manager's fund most immediately previous with at least a five year lag. In the second case, the independent variable was the average ranking of all funds by the same manager at least five years previous. This independent variable was regressed onto the later fund ranking. The null hypothesis is that fund performance is unrelated to the performance of the same manager's fund or funds that predate it by at least five years. The requirement of intervening time resulted in only 13 observations.

Exhibit 16: Regression of Ranking on 5-Year Lagged Ranking

	Performance of Funds at Least 5 Years Previous		Average Performance of Funds at Least 5 Years Previous	
	Gross	Net	Gross	Net
Adjusted R2	0.5072	0.2613	0.2058	0.1084
LR Coefficient	**-0.6770**	**-0.5395**	-0.5098	-0.4234
t-statistic	-3.6537	-2.2899	-2.0273	-1.5679
P-value	0.0038	0.0428	0.0676	0.1452
Intercept	0.8232	0.7887	0.7522	0.7238
t-statistic	7.0999	5.0738	4.5959	4.0580
P-value	0.0000	0.0004	0.0008	0.0019

The results were statistically significant for the regression of a single fund ranking on the subsequent ranking based on both gross and net IRR, and the null hypothesis of no performance persistence can be rejected with 99% and 95% confidence, respectively. For the regression of prior average performance, the relationship is more weakly indicated: based on gross IRR, the null hypothesis can be rejected with 93% confidence, while based on net IRR, it can be rejected with 85% confidence . In contrast to earlier regression results, the coefficient on the lagged ranking is negative in all four cases, suggesting mean reversion in opportunity fund returns. It could also indicate that manager performance is not persistent over longer periods, or that managers pursue a consistent strategy which is only successful at certain times in the market cycle.

A regression analysis was also performed using the performance ranking of the manager's two prior funds as two independent variables. These criteria produced 41 observations over the entire data set and only 11 observations for the period 1991 – 1997. Consistent with earlier analyses, the coefficient on the first lagged variable was positively signed in all cases and allowed rejection of the null hypothesis at a 99% confidence level based on the larger data set and at a 90% confidence level in the reduced data set based on gross IRR. In all cases, the coefficient on the second lagged variable (i.e., fund performance from two funds previous) was negative and statistically significant: the null

hypothesis of no relationship between fund performance and performance of the manager's fund two funds previous can be rejected at a 90% confidence level for all cases except based on gross IRR for all years. The sign of this coefficient suggests that fund performance may be mean reverting. The adjusted R-squared statistics obtained indicate a large part of fund performance is accounted for by the two lagged rankings: up to 16% based on the entire data set, or as much as 29% based on the 1991 – 1997 data.

Exhibit 17: Regression of Ranking on Two Previous Rankings

	All Years		1991-1997	
	Gross	Net	Gross	Net
Adjusted R2	0.1628	0.1557	0.2895	0.2363
Lag Coefficient	**0.5716**	**0.5216**	0.7876	0.4913
t-statistic	3.0795	2.9100	2.0565	1.4002
P-value	0.0039	0.0061	0.0738	0.1990
Lag2 Coefficient	-0.1852	-0.2821	-0.6807	-0.7260
t-statistic	-1.0799	-1.7069	-2.1167	-2.1118
P-value	0.2872	0.0962	0.0672	0.0677
Intercept	0.2980	0.3583	0.4074	0.5628
t-statistic	2.9176	3.2120	2.0040	2.6471
P-value	0.0060	0.0027	0.0800	0.0294

Additional regression analyses with two or more independent variables combined the ranking of previous fund performance with strategic characteristics. It should be noted that these tests were performed only on those managers' funds that had more than one fund in the database. In a regression analysis which assigned dummy variables to global and international focus, with a U.S. focus being the default definition, only the coefficient associated with lagged return was statistically significant. The coefficients associated with both a global and an international focus were negatively signed, suggesting that a domestic strategy was more successful during the studied period.

Regression analyses were also performed combining previous fund performance with fund size and capital raised in the inception year of the fund. Neither fund size nor the amount of money raised for all funds in the vintage year were statistically significant,

while lagged performance continued to be strongly significant. The coefficient on the fund size was positive, while the coefficient on the total capital raised in the vintage year was negative.

An additional analysis of the relationship between fund characteristics and fund performance assigns a dummy variable with a value of '1' if the manager's parent company has a real estate focus, and a value of '0' if it is not primarily real estate focused. This analysis found a real estate focus to have a positive association with fund performance that is statistically significant at the 10% level. This relationship may indicate that the desired level of alignment of interests and incentive may not be being achieved by larger, less specialized managers, even though that investment banks may have a higher level of co-investment than smaller general partners.[46] However, when analyzed in combination with a variable for previous fund return, the coefficient on the real estate-focused variable is not significant, although it is still positively signed.

Exhibit 18: Regression of Net Ranking on Gross Ranking

	All Managers	Mangers of Multiple Funds
Adjusted R2	0.8995	0.8508
GR Coefficient	**0.9484**	**0.9186**
t-statistic	31.0952	19.5728
P-value	0.0000	0.0000
Intercept	0.0258	0.0404
t-statistic	1.4311	1.4979
P-value	0.1553	0.1389

Because of the indicated difference in strength of performance persistence between gross and net rankings, a final analysis regressed fund net return rankings on gross return rankings. The null hypothesis was that gross and net returns are independent. The findings were strongly significant both based on all funds in the

[46] While general partners coinvestments typically constitute 1-5% of their funds, general partners associated with investment banks may invest up to 40% of the fund. (Ernst & Young, "Opportunistic Investing: Real Estate Private Equity Funds", 2002, p. 1.)

database and on just funds by managers with two or more funds, and the null hypothesis can be rejected with 99% confidence. The adjusted R-squared statistic based on all funds was 90%, while for funds that were one of multiple by the same manager, the adjusted R-squared was 85%. The difference in the statistic indicates that the connection between gross and net rankings is not as strong when managers have had more than one fund.

VII. Topics for Further Inquiry

Many topics remain for further study. Fund characteristics should be studied independently from previous performance. With additional information on fund assets, as well as the passage of time, it would be possible to research if opportunity funds, like hedge funds, have particular strategies that consistently outperform other strategies, or if successful strategies are cyclical, varying over time. The amount of time between the inception of a fund and the time at which it has been fully or significantly invested is another characteristic that remains to be investigated.

As a secondary market develops,[47] more frequent interim return data may be available, creating many opportunities for future inquiry. Volatility of funds could be checked, manager valuation could be compared with market valuation, and the impact of increased liquidity could be examined.

The compensation structure of funds and its impact on returns stand out as a good subject for further research. The weaker relationship indicated between fund performances when measured by net IRRs suggests that fees may be diluting some of the high fund returns. Possible relationships between the underlying compensation structure, including fee performance incentives, co-investment percentage, and proportion of joint venture deals, and the difference in gross versus net performance could be explored. Further research on the importance of individual personnel on performance, in addition to the role of the corporate entity as general partner, may also provide insight.

[47] Seminar, "Liquidity Through Secondary Market Transactions," Fourth Annual U.S. Real Estate Opportunity & Private Fund Investing Forum, Information Management Network, May 29, 2003.

VIII. Conclusion

For real estate opportunity funds, the performance of a manager's fund is an indicator of that manager's future fund performance. The performance of a manager's earlier fund can accounts for as much as 20-24% of a subsequent fund's ranking relative to its vintage year peers. This represents a significant relationship, especially since a brief analysis of other possible indicators of returns failed to identify other significant associations. Individual fund returns are more indicative of future fund performance than is the average performance of all a managers' previous funds.

For investors, the finding of return correlation will be tempered by the fact that performance is apparently less persistent when measured by a net IRR than when based on a gross IRR. This finding suggests that fund managers may benefit most from persistent above-average returns, and suffer most from persistent below-average returns. The analyses based on the limited data set of funds which might be at or near liquidation found weaker evidence for persistence: it is impossible to conclude if this is due to the small size of the sample or because there is truly less or no serial performance correlation among these funds.

One caveat to the finding of performance persistence among managers' opportunity fund returns is that this result is likely biased by the attrition of under-performing funds from the database. The likelihood of attrition is reinforced by the results of the analysis regressing the existence of a prior fund on fund performance, which weakly suggest that only top-performing fund managers get a chance to raise a second fund. However, even though the results may be biased towards an indication of performance persistence due to attrition, they are consistent in their indication of persistence. Both the chi-squared test, strongest in the presence of attrition bias, and the Spearman rank correlation coefficient, powerful in the absence of attrition bias, support the finding of performance correlation. While adjustments to compensate for attrition

have been identified, they require annual performance measures and standard deviations,[48] statistics which are unavailable for opportunity funds.

An additional qualification pertains to the calculations underlying the data set. As opportunity funds are still a relatively recent development, most of the funds have not yet completed their anticipated life cycle, and fewer still have fully liquidated. Thus, return statistics are only as good as the managers' valuations. An investigation of performance and performance persistence's sensitivity to terminal values assigned by managers is an area where further work is possible. The passage of time will increase the quantity and reliability of return information: a revisiting of this study in five or ten years' time will be illuminating.

No matter how strong the statistical indication of performance persistence, one difficulty with using the performance of one fund to predict the performance of a subsequent fund is the life cycle of real estate opportunity funds. In order to capitalize on the knowledge that fund performance is most strongly linked to the performance of the fund immediately preceding it, an investor would need the ability to compare returns among several recent funds: until current transparency and reporting issues are resolved, this will be difficult at best. With an expected investment commitment of five years or more, performance cannot be accurately measured until well into the fund life, possibly after the next investment decision must be made.

The results indicate that even a good track record accounts for a small part of future fund performance. Even if a manager achieves above-average performance, it does not mean that the targeted 15-20% return has been met or exceeded, or that the risk undertaken was proportional to the return achieved. Management and investors alike may have a more ambitious definition of successful performance than merely outperforming the median: if a more stringent definition of success is established, for

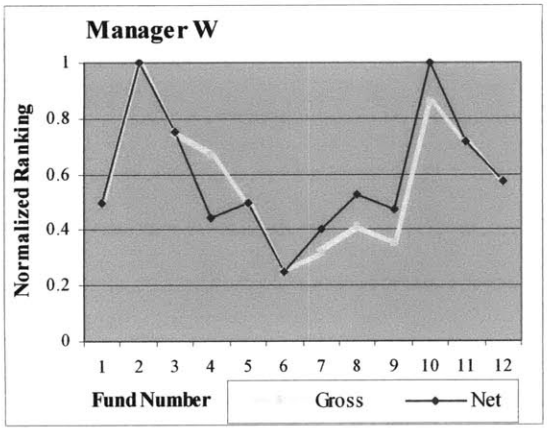
[48] Brown, Goetzmann, Ibbotson, Ross, "Survivorship Bias in Performance Studies." The Review of Financial Studies Volume 5, no. 4, 1992, p. 572 – 575.

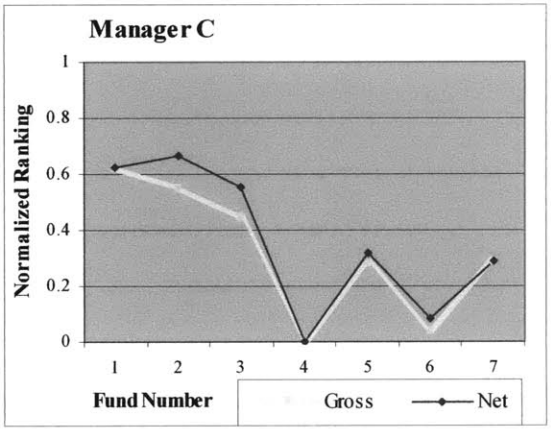
example a rating in the top third or quartile of funds of a vintage year, there is still evidence of persistence.

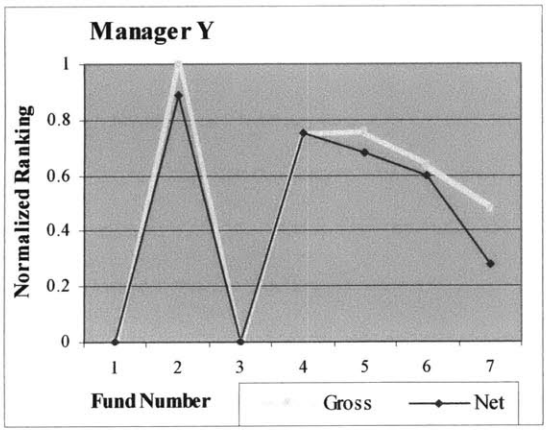
Even tests strongly disproving the null hypothesis of no relationship between past and subsequent fund performance give no indication of what aspect of the managers' involvement results in return correlation. It is important to keep in mind that fund performance itself does not cause correlated subsequent fund performance, but must represent some other unidentified element. Consistent returns may be due to a wide variety of factors: consistent strategy or flexible responses to circumstances, performance incentives or integrated management structure. Until the manager characteristics that enable the achievement of consistently high or low results can be identified, past fund performance will serve as a surrogate indicator of future performance.

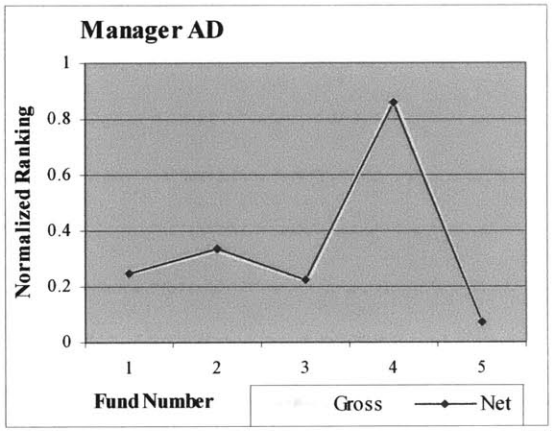
IX. Appendix

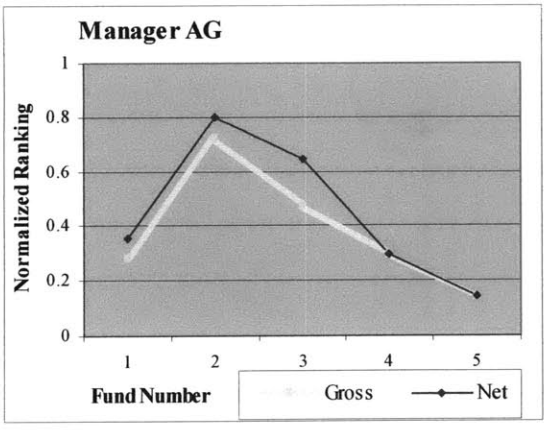
Chronological Plots of Manager Performance

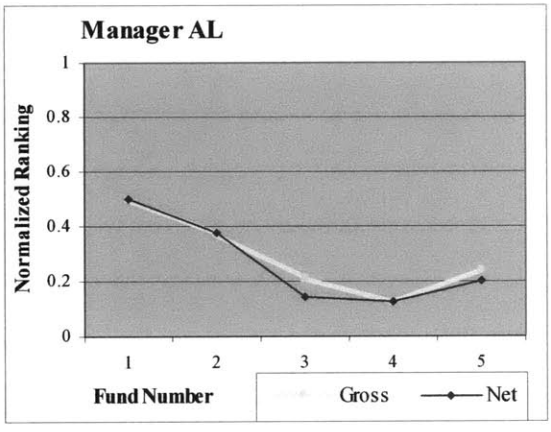




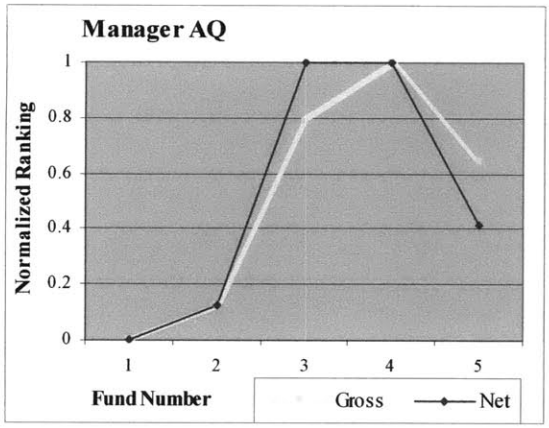


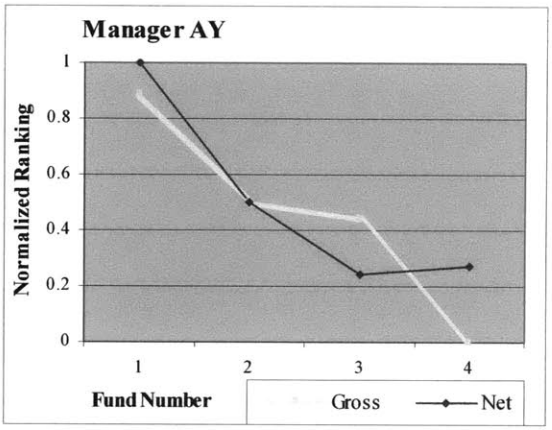


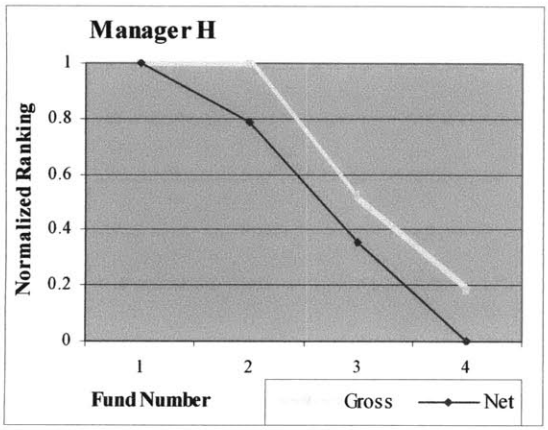


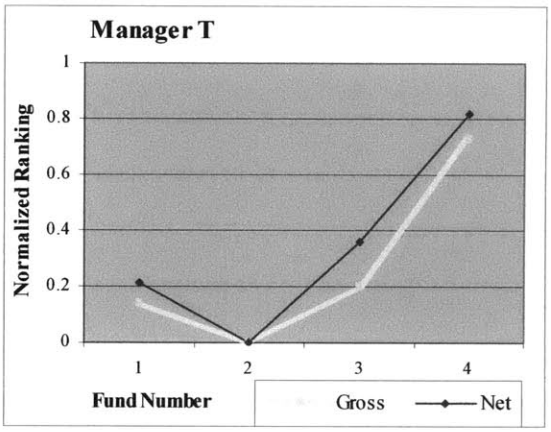


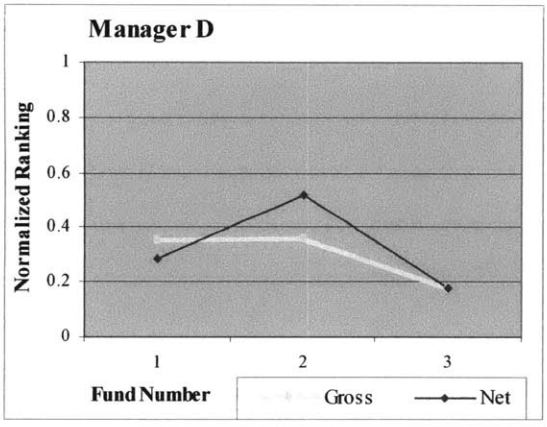
Chronological Plots of Manager Performance

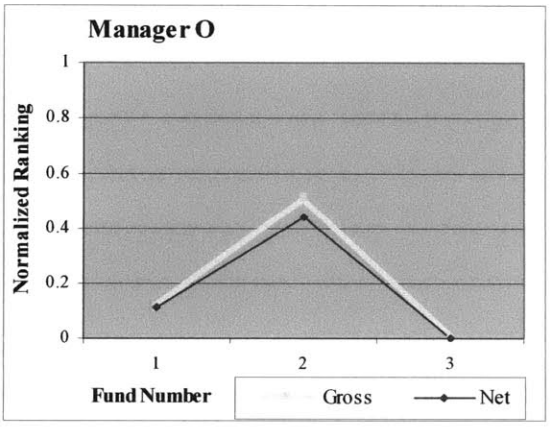




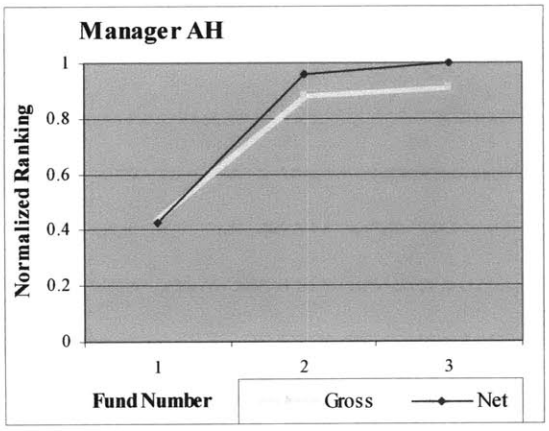


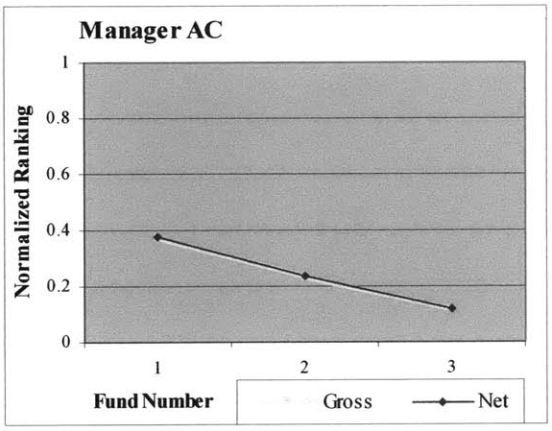


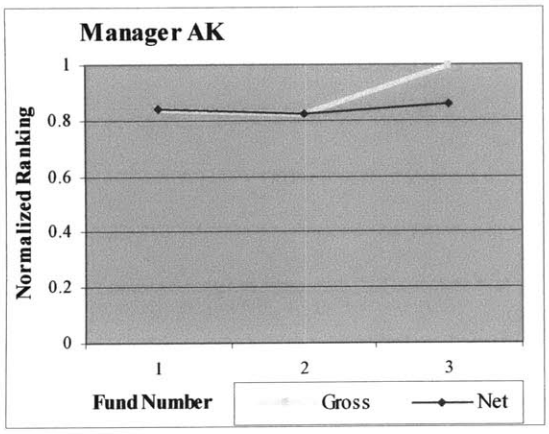


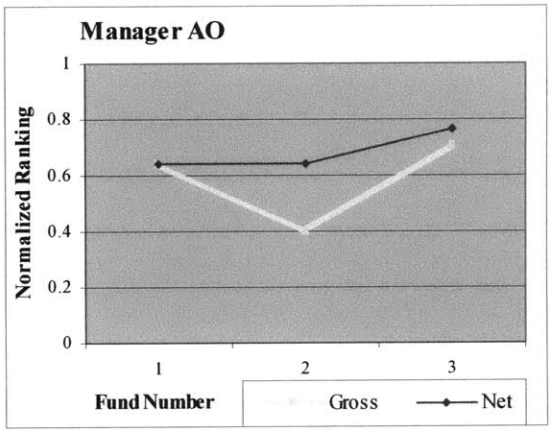


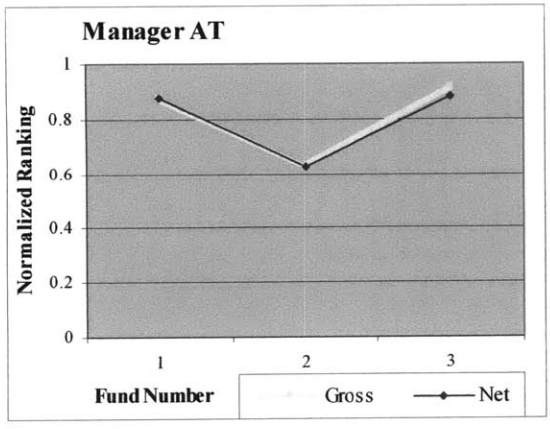
Chronological Plots of Manager Performance

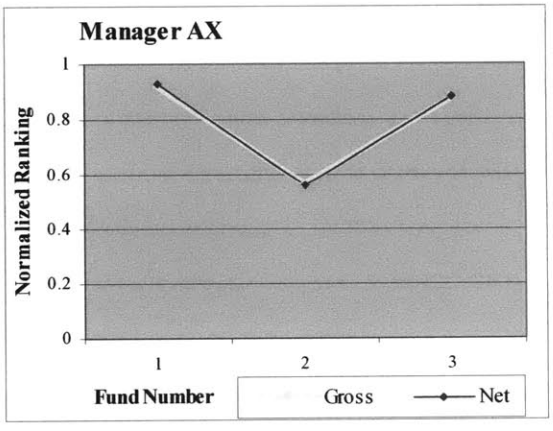




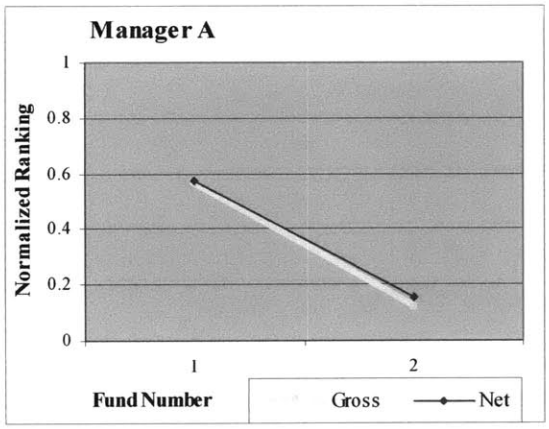


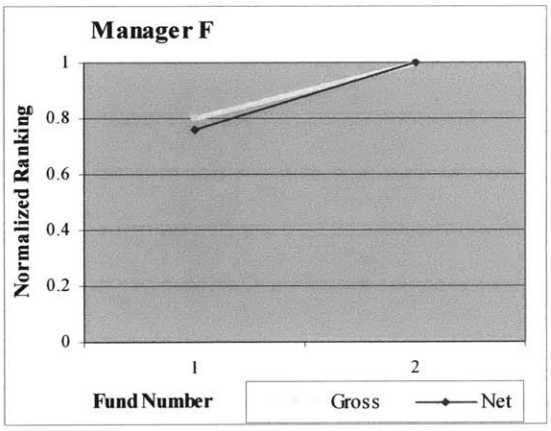


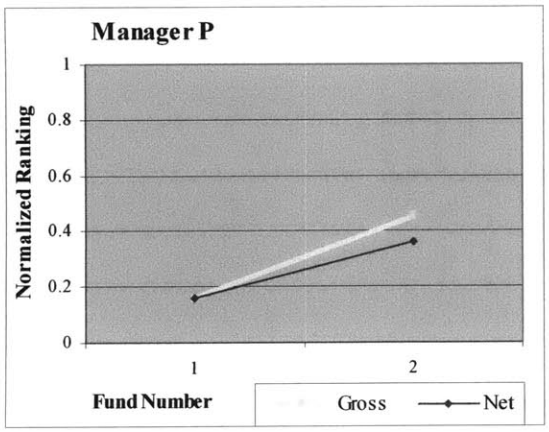


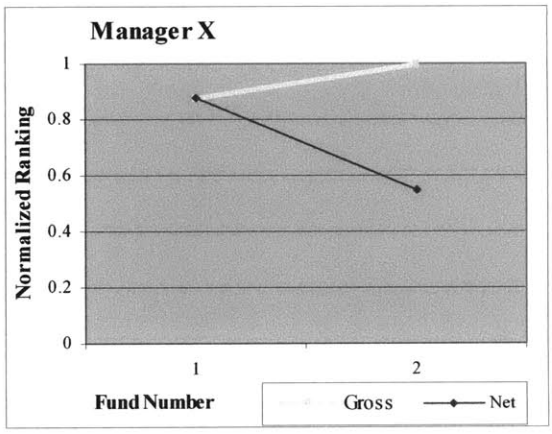


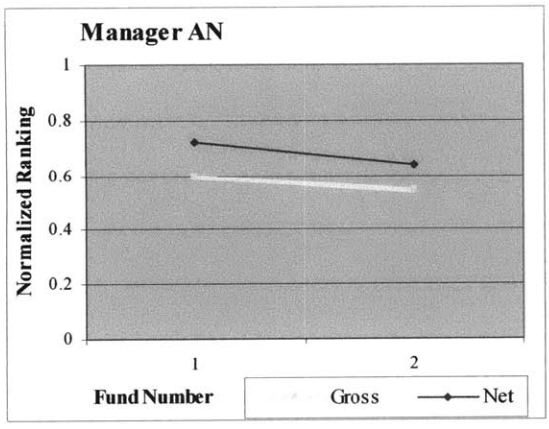
Chronological Plots of Manager Performance

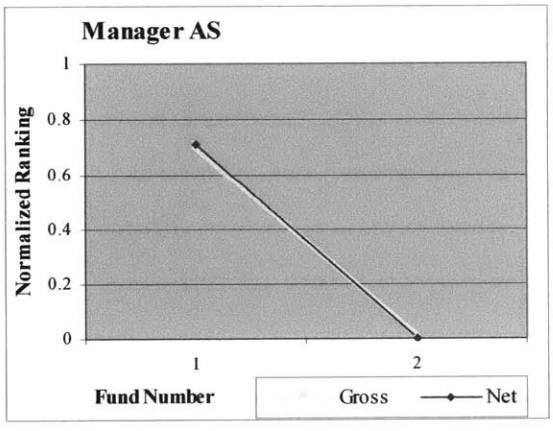












Regression Output: Fund Ranking on Existence of Previous Fund

Independent Variable: Existence of Previous Fund (1=Previous Fund)
Dependent Variable: Ranking Based on Gross IRR

SUMMARY OUTPUT

NR = 0.575 - 0.048F

Regression Statistics	
Multiple R	0.080863109
R Square	0.006538842
Adjusted R Square	-0.002659872
Standard Error	0.292558307
Observations	110

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.060841316	0.060841316	0.710843064	0.401027492
Residual	108	9.243759176	0.085590363		
Total	109	9.304600492			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.574811171	0.044614723	12.88388957	1.43657E-23	0.486377162	0.663245179	0.486377162	0.663245179
Fund	-0.048197445	0.057165913	-0.843115095	0.401027492	-0.161510057	0.065115168	-0.161510057	0.065115168

Independent Variable: Existence of Previous Fund (1=Previous Fund)
Dependent Variable: Ranking Based on Net IRR

SUMMARY OUTPUT

NR = 0.570 - 0.040F

Regression Statistics	
Multiple R	0.066049055
R Square	0.004362478
Adjusted R Square	-0.004856388
Standard Error	0.292878583
Observations	110

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.040591112	0.040591112	0.473211972	0.49298802
Residual	108	9.26400938	0.085777865		
Total	109	9.304600492			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.569897232	0.045192147	12.61053692	5.823E-23	0.480318673	0.659475792	0.480318673	0.659475792
Fund	-0.039539641	0.057478425	-0.687904042	0.49298802	-0.153471704	0.074392422	-0.153471704	0.074392422

Regression Output: Fund Ranking on Existence of Previous Fund (1991-1997)

Independent Variable: Existence of Previous Fund (1=Previous Fund)
Dependent Variable: Ranking Based on Gross IRR (1991-1997)

SUMMARY OUTPUT

NR = 0.583 - 0.038F

Regression Statistics	
Multiple R	0.06455032
R Square	0.004166744
Adjusted R Square	-0.01846583
Standard Error	0.299090551
Observations	46

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.016469038	0.016469038	0.184103842	0.669963564
Residual	44	3.936026936	0.089455158		
Total	45	3.952495974			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.583333333	0.061051603	9.554758666	2.67052E-12	0.460291917	0.70637475	0.460291917	0.70637475
Fund	-0.037878788	0.088280472	-0.429073236	0.669963564	-0.215796382	0.140038807	-0.215796382	0.140038807

Independent Variable: Existence of Previous Fund (1=Previous Fund)
Dependent Variable: Ranking Based on Net IRR (1991-1997)

SUMMARY OUTPUT

NR = 0.578 - 0.026F

Regression Statistics	
Multiple R	0.044497603
R Square	0.001980037
Adjusted R Square	-0.020702235
Standard Error	0.299418751
Observations	46

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.007826087	0.007826087	0.08729446	0.769035105
Residual	44	3.944669887	0.089651588		
Total	45	3.952495974			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.57826087	0.062433125	9.262084286	6.72764E-12	0.452435178	0.704086561	0.452435178	0.704086561
Fund	-0.026086957	0.088293773	-0.295456358	0.769035105	-0.204031356	0.151857443	-0.204031356	0.151857443

Regression Output: Fund Ranking on Lagged Ranking

Independent Variable: Lagged Ranking Based on Gross IRR
Dependent Variable: Subsequent Ranking Based on Gross IRR

SUMMARY OUTPUT

S = 0.247 + 0.494LR

Regression Statistics	
Multiple R	0.465130452
R Square	0.216346338
Adjusted R Square	0.204472797
Standard Error	0.27063334
Observations	68

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	1.334540967	1.334540967	18.22087866	6.43182E-05
Residual	66	4.833998704	0.073242405		
Total	67	6.168539671			

	Coefficients	*Std Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.246215995	0.065654461	3.750179226	0.000374656	0.115132682	0.377299308	0.115132682	0.377299308
LR	0.493919071	0.115710065	4.268592117	6.43182E-05	0.262896556	0.724941587	0.262896556	0.724941587

Independent Variable: Lagged Ranking Based on Net IRR
Dependent Variable: Subsequent Ranking Based on Net IRR

SUMMARY OUTPUT

S = 0.280 + 0.415LR

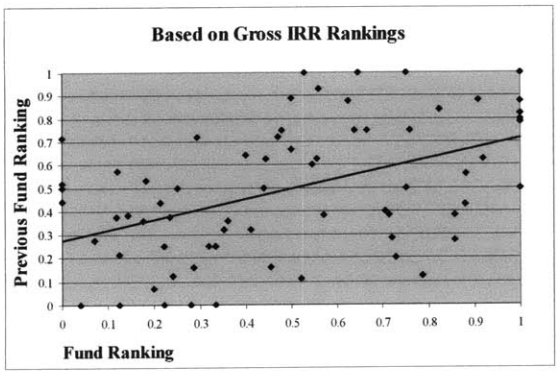
Regression Statistics	
Multiple R	0.398137823
R Square	0.158513726
Adjusted R Square	0.145763934
Standard Error	0.278929245
Observations	68

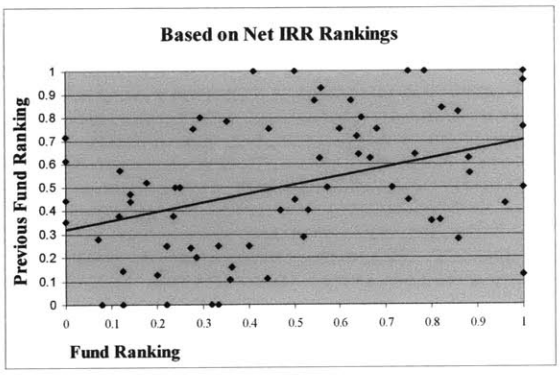
ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.967279263	0.967279263	12.43265187	0.000772601
Residual	66	5.134900582	0.077801524		
Total	67	6.102179845			

	Coefficients	*Std Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.27986833	0.068407121	4.091216331	0.000119081	0.143289156	0.416447504	0.143289156	0.416447504
LR	0.414544431	0.117568019	3.525996579	0.000772601	0.179812394	0.649276469	0.179812394	0.649276469

Scatterplot: Fund Ranking on Lagged Ranking





Regression Output: Fund Ranking on Lagged Ranking (1991-1997)

Independent Variable: Lagged Ranking Based on Gross IRR 1991 - 1997
Dependent Variable: Subsequent Ranking Based on Gross IRR 1991 - 1997

SUMMARY OUTPUT

S = 0.238 + 0.530LR

Regression Statistics	
Multiple R	0.527702531
R Square	0.278469961
Adjusted R Square	0.244111388
Standard Error	0.275025205
Observations	23

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.613039172	0.613039172	8.104817364	0.009656285
Residual	21	1.588416128	0.075638863		
Total	22	2.2014553			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.238283299	0.106174106	2.244269421	0.035719377	0.01748212	0.459084478	0.01748212	0.459084478
LR	0.529553739	0.186010912	2.846896093	0.009656285	0.142722804	0.916384675	0.142722804	0.916384675

Independent Variable: Lagged Ranking Based on Net IRR 1991 - 1997
Dependent Variable: Subsequent Ranking Based on Net IRR 1991 - 1997

SUMMARY OUTPUT

S = 0.293 + 0.405LR

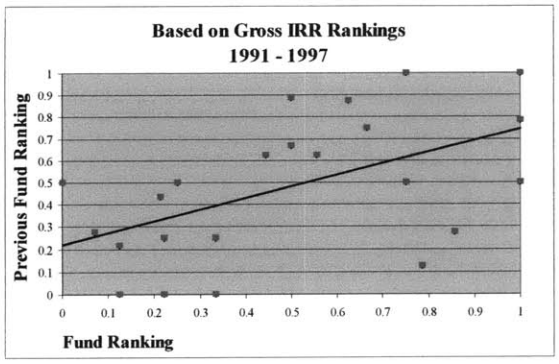
Regression Statistics	
Multiple R	0.427174221
R Square	0.182477816
Adjusted R Square	0.143548188
Standard Error	0.295702562
Observations	23

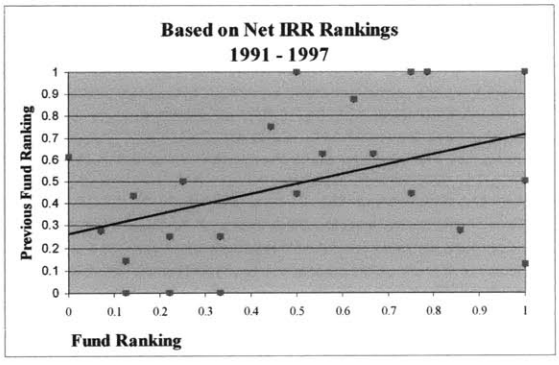
ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.40986421	0.40986421	4.687376316	0.042049805
Residual	21	1.83624011	0.087440005		
Total	22	2.246104319			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.293244374	0.109653699	2.67427709	0.014195669	0.065206985	0.521281763	0.065206985	0.521281763
LR	0.405471932	0.187281934	2.165034946	0.042049805	0.015997761	0.794946102	0.015997761	0.794946102

Scatterplot: Fund Ranking on Lagged Ranking (1991-1997)





Regression Output: Fund Ranking on Average Previous Ranking

Independent Variable: Average Previous Ranking Based on Net IRR
Dependent Variable: Subsequent Ranking Based on Net IRR

SUMMARY OUTPUT

S = 0.347 + 0.281AR

Regression Statistics	
Multiple R	0.22983353
R Square	0.052823452
Adjusted R Square	0.038472292
Standard Error	0.295927961
Observations	68

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.322338202	0.322338202	3.680779274	0.059370007
Residual	66	5.779841643	0.087573358		
Total	67	6.102179845			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.346656119	0.082661852	4.193665028	8.35632E-05	0.181616466	0.511695773	0.181616466	0.511695773
AR	0.280505031	0.146207876	1.918535711	0.059370007	-0.011408306	0.572418369	-0.01140831	0.572418369

Independent Variable: Average Previous Ranking Based on Gross IRR
Dependent Variable: Subsequent Ranking Based on Gross IRR

SUMMARY OUTPUT

S = 0.297 + 0.384AR

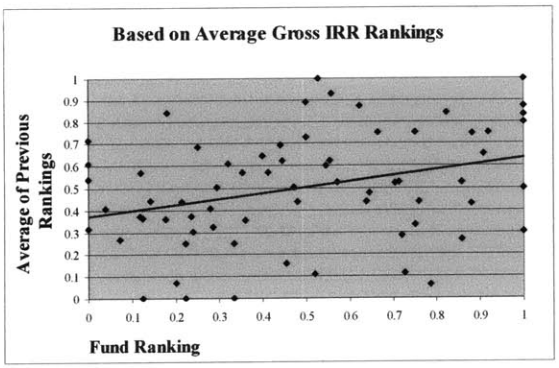
Regression Statistics	
Multiple R	0.317082754
R Square	0.100541473
Adjusted R Square	0.086913313
Standard Error	0.289941102
Observations	68

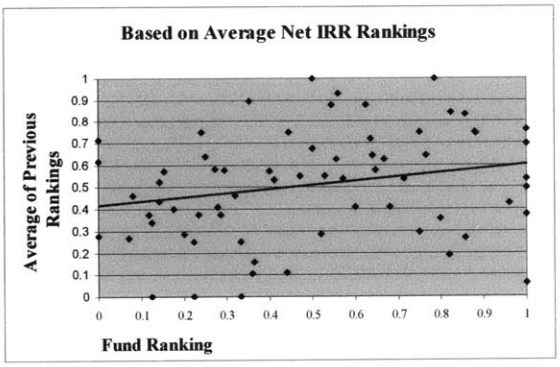
ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.620194063	0.620194063	7.377479894	0.008423246
Residual	66	5.548345608	0.084065843		
Total	67	6.168539671			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.296673247	0.079038347	3.753535577	0.00037055	0.138868153	0.454478341	0.138868153	0.454478341
AR	0.38350682	0.141194921	2.71615167	0.008423246	0.101602167	0.665411472	0.101602167	0.665411472

Scatterplot: Fund Ranking on Average Previous Ranking





Regression Output: Fund Ranking on Average Previous Ranking (1991-1997)

Independent Variable: Average Previous Ranking Based on Net IRR 1991-1997
Dependent Variable: Subsequent Ranking Based on Net IRR 1991-1997

SUMMARY OUTPUT

S = 0.366 + 0.242AR

Regression Statistics	
Multiple R	0.236260007
R Square	0.055818791
Adjusted R Square	0.014767434
Standard Error	0.309916554
Observations	25

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.130599783	0.130599783	1.35973071	0.255533978
Residual	23	2.209110223	0.096048271		
Total	24	2.339710006			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.366367988	0.110328275	3.320708014	0.002977892	0.138136872	0.594599104	0.138136872	0.594599104
AR	0.242021961	0.207552669	1.166074916	0.255533978	-0.187332862	0.671376784	-0.18733286	0.671376784

Independent Variable: Average Previous Ranking Based on Gross IRR 1991-1997
Dependent Variable: Subsequent Ranking Based on Gross IRR 1991-1997

SUMMARY OUTPUT

S = 0.308 + 0.373AR

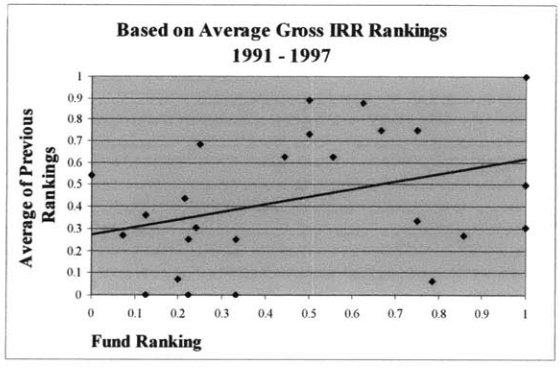
Regression Statistics	
Multiple R	0.359201807
R Square	0.129025938
Adjusted R Square	0.0911575
Standard Error	0.297617785
Observations	25

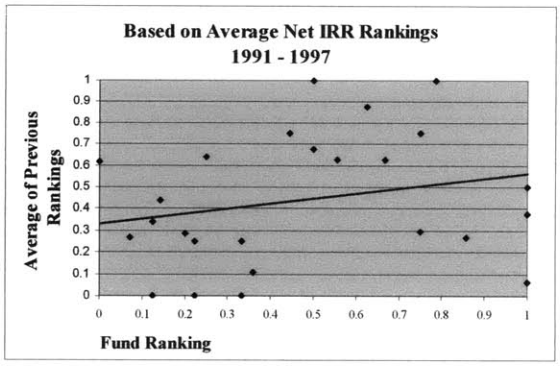
ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.301798723	0.301798723	3.407215782	0.077823469
Residual	23	2.037255954	0.088576346		
Total	24	2.339054677			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.308397563	0.10624967	2.902574321	0.008023593	0.088603674	0.528191451	0.088603674	0.528191451
AR	0.373288197	0.202229467	1.845864508	0.077823469	-0.045054761	0.791631154	-0.04505476	0.791631154

Scatterplot: Fund Ranking on Average Previous Ranking (1991-1997)





Regression Output: Fund Ranking on Two Lagged Rankings

Independent Variable: Lagged Ranking Based on Gross IRR
Independent Variable: Second Lagged Ranking Based on Gross IRR
Dependent Variable: Subsequent Ranking Based on Gross IRR

SUMMARY OUTPUT

S = 0.298 + 0.572LR - 0.185LLR

Regression Statistics	
Multiple R	0.453593753
R Square	0.205747293
Adjusted R Square	0.162814714
Standard Error	0.281265127
Observations	40

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.758243907	0.379121953	4.792334835	0.014100549
Residual	37	2.927072661	0.079110072		
Total	39	3.685316568			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.298008878	0.102141077	2.917620266	0.00596607	0.091051598	0.504966157	0.091051598	0.504966157
LLR	-0.18520894	0.171500139	-1.07993466	0.287160789	-0.532700895	0.162283006	-0.53270089	0.162283006
LR	0.571601328	0.185616957	3.07946719	0.003896991	0.195506016	0.94769664	0.195506016	0.94769664

Independent Variable: Lagged Ranking Based on Net IRR
Independent Variable: Second Lagged Ranking Based on Net IRR
Dependent Variable: Subsequent Ranking Based on Net IRR

SUMMARY OUTPUT

S = 0.358 + 0.522LR - 0.282LLR

Regression Statistics	
Multiple R	0.446069114
R Square	0.198977655
Adjusted R Square	0.155679149
Standard Error	0.29136978
Observations	40

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.780279888	0.390139944	4.595485547	0.016497787
Residual	37	3.141164905	0.084896349		
Total	39	3.921444793			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.358317401	0.111557163	3.211962282	0.002728958	0.132281338	0.584353463	0.132281338	0.584353463
LLR	-0.28214975	0.165296546	-1.7069307	0.096215462	-0.617072037	0.05277254	-0.61707204	0.05277254
LR	0.521591765	0.179242151	2.909983854	0.006085548	0.158413024	0.884770506	0.158413024	0.884770506

Regression Output: Fund Ranking on Two Lagged Rankings (1991-1997)

Independent Variable: Lagged Ranking Based on Gross IRR 1991-1997
Independent Variable: Second Lagged Ranking Based on Gross IRR 1991-1997
Dependent Variable: Subsequent Ranking Based on Gross IRR 1991-1997

SUMMARY OUTPUT

S = 0.407 + 0.788LR - 0.681LLR

Regression Statistics	
Multiple R	0.656933582
R Square	0.431561732
Adjusted R Square	0.289452164
Standard Error	0.29716526
Observations	11

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.536346784	0.268173392	3.036823912	0.104407869
Residual	8	0.706457535	0.088307192		
Total	10	1.242804319			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.40741835	0.203307396	2.003952429	0.080024686	-0.061409649	0.876246348	-0.06140965	0.876246348
LLR	-0.68069896	0.321590969	-2.11666068	0.067173415	-1.422289541	0.060891625	-1.42228954	0.060891625
LR	0.787605318	0.382989319	2.056468102	0.073763537	-0.095570207	1.670780843	-0.09557021	1.670780843

Independent Variable: Lagged Ranking Based on Net IRR 1991-1997
Independent Variable: Second Lagged Ranking Based on Net IRR 1991-1997
Dependent Variable: Subsequent Ranking Based on Net IRR 1991-1997

SUMMARY OUTPUT

S = 0.563 + 0.491LR - 0.726LLR

Regression Statistics	
Multiple R	0.623737097
R Square	0.389047966
Adjusted R Square	0.236309957
Standard Error	0.325441069
Observations	11

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.539548806	0.269774403	2.547158822	0.13932481
Residual	8	0.847295115	0.105911889		
Total	10	1.386843921			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.562822453	0.212621894	2.647057846	0.029389661	0.072515169	1.053129737	0.072515169	1.053129737
LLR	-0.72604354	0.34379509	-2.11184964	0.067678235	-1.518836949	0.066749874	-1.51883695	0.066749874
LR	0.491341927	0.350911765	1.400186531	0.199025568	-0.317862578	1.300546432	-0.31786258	1.300546432

Regression Output: Fund Ranking on 5-Year Lagged Ranking

Independent Variable: 5-Year Lagged Ranking Based on Gross IRR
Dependent Variable: Subsequent Ranking Based on Gross IRR

SUMMARY OUTPUT

S = 0.823 - 0.677LR

Regression Statistics	
Multiple R	0.740437713
R Square	0.548248006
Adjusted R Square	0.507179643
Standard Error	0.206715769
Observations	13

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.570449079	0.570449079	13.3496435	0.003796013
Residual	11	0.470045501	0.042731409		
Total	12	1.040494579			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.823247726	0.115952731	7.099856254	1.99354E-05	0.568037355	1.078458096	0.568037355	1.078458096
LR	-0.6769567	0.18527894	-3.653716396	0.003796013	-1.084753104	-0.2691603	-1.084753104	-0.269160297

Independent Variable: 5-Year Lagged Ranking Based on Net IRR
Dependent Variable: Subsequent Ranking Based on Net IRR

SUMMARY OUTPUT

S = 0.789 - 0.540LR

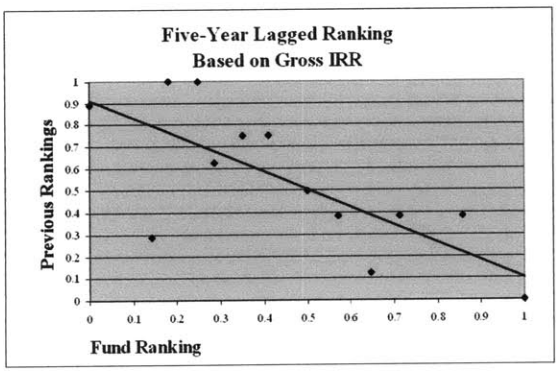
Regression Statistics	
Multiple R	0.568173465
R Square	0.322821087
Adjusted R Square	0.261259367
Standard Error	0.25888289
Observations	13

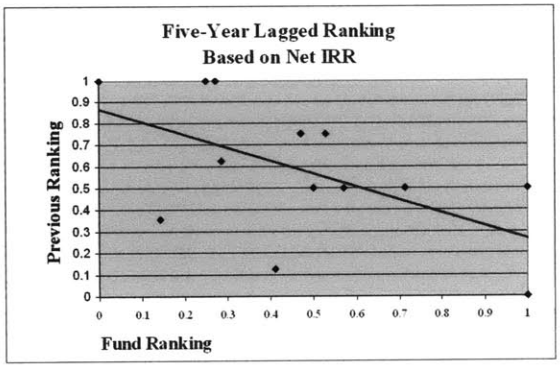
ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.351445391	0.351445391	5.243860791	0.042781608
Residual	11	0.73722386	0.067020351		
Total	12	1.088669251			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.788692087	0.155443999	5.073802104	0.000358443	0.44656198	1.130822194	0.44656198	1.130822194
LR	-0.539521804	0.235604415	-2.28994777	0.042781608	-1.058083887	-0.02095972	-1.058083887	-0.020959721

Scatterplot: Fund Ranking on 5-Year Lagged Ranking





Regression Output: Fund Ranking on 5-Year Lagged Average Rankings

Independent Variable: 5-Year Lagged Average Ranking Based on Gross IRR
Dependent Variable: Subsequent Ranking Based on Gross IRR

SUMMARY OUTPUT

S = 0.752 - 0.510AR

Regression Statistics	
Multiple R	0.521541898
R Square	0.272005952
Adjusted R Square	0.205824675
Standard Error	0.262414291
Observations	13

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.283020718	0.283020718	4.110013642	0.067561705
Residual	11	0.757473861	0.06886126		
Total	12	1.040494579			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.752187083	0.163664021	4.595922049	0.000770039	0.391964819	1.112409347	0.391964819	1.112409347
AR	-0.509768828	0.251450002	-2.02731686	0.067561705	-1.063206831	0.043669175	-1.06320683	0.043669175

Independent Variable: 5-Year Lagged Average Ranking Based on Net IRR
Dependent Variable: Subsequent Ranking Based on Net IRR

SUMMARY OUTPUT

S = 0.724 - 0.423AR

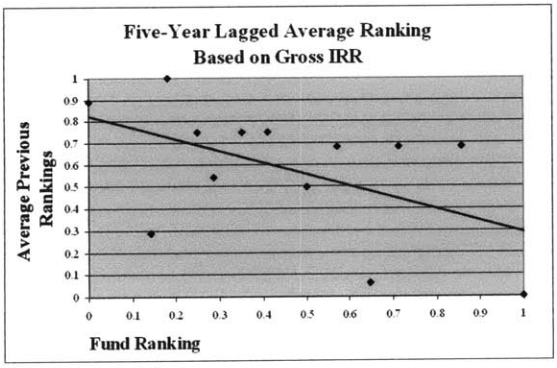
Regression Statistics	
Multiple R	0.427398442
R Square	0.182669428
Adjusted R Square	0.108366649
Standard Error	0.284413697
Observations	13

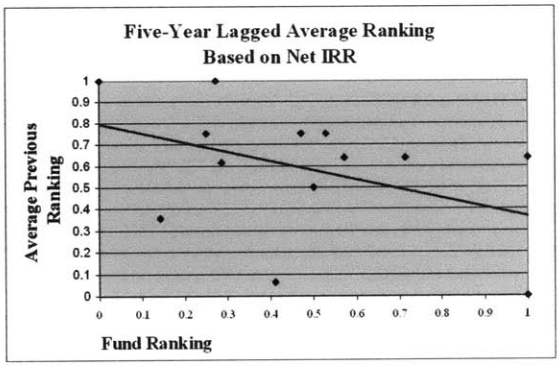
ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.19886659	0.19886659	2.458446782	0.145192285
Residual	11	0.889802661	0.080891151		
Total	12	1.088669251			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.723820964	0.178369514	4.057985857	0.001889674	0.331232113	1.116409815	0.331232113	1.116409815
AR	-0.423380103	0.270022553	-1.56794349	0.145192285	-1.017696035	0.170935829	-1.01769603	0.170935829

Scatterplot: Fund Ranking on 5-Year Lagged Average Ranking





Regression Output: Fund Ranking on Lagged Ranking, Size of Fund, and Funds Raised in Vintage Year

Independent Variable: Lagged Ranking Based on Net IRR
Independent Variable: Size of Fund
Independent Variable: Amount of Funds Raised for All Funds in Vintage Year
Dependent Variable: Subsequent Ranking Based on Net IRR

SUMMARY OUTPUT

S = 0.416 + 0.295LR + 0SIZE + 0YRSZ

Regression Statistics	
Multiple R	0.307858065
R Square	0.094776588
Adjusted R Square	0.050257404
Standard Error	0.281189183
Observations	65

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	0.504977872	0.168325957	2.128893197	0.105776041
Residual	61	4.823108741	0.079067356		
Total	64	5.328086613			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.416270102	0.108893066	3.822742056	0.000312276	0.198524898	0.634015305	0.198524898	0.634015305
LR	0.2949119	0.130416221	2.261313025	0.027316969	0.034128475	0.555695326	0.034128475	0.555695326
SIZE	1.54995E-05	6.98385E-05	0.221933438	0.825107039	-0.000124151	0.00015515	-0.000124151	0.00015515
YRSZ	-7.59423E-06	8.60681E-06	-0.88235093	0.381050966	-2.48046E-05	9.61616E-06	-2.48046E-05	9.61616E-06

Independent Variable: Size of Fund
Dependent Variable: Subsequent Ranking Based on Net IRR

SUMMARY OUTPUT

S = 0.521 + 0SIZE

Regression Statistics	
Multiple R	0.037110164
R Square	0.001377164
Adjusted R Square	-0.014473992
Standard Error	0.290613717
Observations	65

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.00733765	0.00733765	0.086880997	0.769149539
Residual	63	5.320748962	0.084456333		
Total	64	5.328086613			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.521037527	0.050976925	10.22104672	5.30035E-15	0.41916821	0.622906844	0.41916821	0.622906844
Size	2.07834E-05	7.05105E-05	0.294755826	0.769149539	-0.000120121	0.000161688	-0.000120121	0.000161688

Regression Output: Fund Ranking on Lagged Ranking, Institutional Affiliation, and Investment Region

Independent Variable: Lagged Ranking Based on Net IRR
Independent Variable: Institutional Affiliation (1=Real Estate Focus)
Independent Variable: Investment Region: Global (1 = Global Strategy)
Independent Variable: Investment Region: International (1=International Strategy)
Dependent Variable: Subsequent Ranking Based on Net IRR

SUMMARY OUTPUT

S = 0.346 + 0.282LR + 0.081RE - 0.068G - 0.09INT

Regression Statistics	
Multiple R	0.348618434
R Square	0.121534813
Adjusted R Square	0.062970467
Standard Error	0.279300871
Observations	65

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	0.647548009	0.161887002	2.075235557	0.095240138
Residual	60	4.680538604	0.078008977		
Total	64	5.328086613			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.34609323	0.091868316	3.767275209	0.000378558	0.162329297	0.529857163	0.162329297	0.529857163
LR	0.281755789	0.130774685	2.154513232	0.035224722	0.020167557	0.543344021	0.020167557	0.543344021
RE	0.081253049	0.073579879	1.104283545	0.273879114	-0.065928574	0.228434672	-0.065928574	0.228434672
G	-0.068052273	0.077872996	-0.87388796	0.385663665	-0.223821406	0.08771686	-0.223821406	0.08771686
INT	-0.089574412	0.168775656	-0.53073064	0.597564506	-0.42717588	0.248027055	-0.42717588	0.248027055

Independent Variable: Investment Region: Global (1 = Global Strategy)
Independent Variable: Investment Region: International (1=International Strategy)
Dependent Variable: Ranking Based on Net IRR

SUMMARY OUTPUT

S = 0.559 - 0.073G - 0.143INT
Note: if both dummy variables = 0 , then fund invests in U.S. assets only.

Regression Statistics	
Multiple R	0.144248972
R Square	0.020807766
Adjusted R Square	-0.01077908
Standard Error	0.290083999
Observations	65

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.110865579	0.055432789	0.658747812	0.521082844
Residual	62	5.217221034	0.084148726		
Total	64	5.328086613			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.55944524	0.044237395	12.64643269	8.01403E-19	0.471016044	0.647874435	0.471016044	0.647874435
G	-0.07250111	0.079911373	-0.90726899	0.367777436	-0.232241491	0.087239271	-0.232241491	0.087239271
INT	-0.142789684	0.173223909	-0.82430702	0.41292511	-0.489058961	0.203479593	-0.489058961	0.203479593

Regression Output: Fund Ranking on Lagged Ranking and Institutional Affiliation

Independent Variable: Institutional Affiliation (1=Real Estate Focus)
Dependent Variable: Ranking Based on Net IRR

SUMMARY OUTPUT

S = 0.458 + 0.120RE

Regression Statistics	
Multiple R	0.204704939
R Square	0.041904112
Adjusted R Square	0.026696241
Standard Error	0.284655678
Observations	65

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.223268738	0.223268738	2.755422593	0.101895295
Residual	63	5.104817875	0.081028855		
Total	64	5.328086613			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.457528342	0.056931136	8.036522312	3.07998E-11	0.343760476	0.571296208	0.343760476	0.571296208
RE	0.120467705	0.072573243	1.659946563	0.101895295	-0.024558437	0.265493847	-0.024558437	0.265493847

Independent Variable: Lagged Ranking Based on Net IRR
Independent Variable: Institutional Affiliation (1=Real Estate Focus)
Dependent Variable: Subsequent Ranking Based on Net IRR

SUMMARY OUTPUT

S = 0.317 + 0.277LR + 0.095RE

Regression Statistics	
Multiple R	0.328650497
R Square	0.108011149
Adjusted R Square	0.079237315
Standard Error	0.276865924
Observations	65

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.575492758	0.287746379	3.753797617	0.028916266
Residual	62	4.752593855	0.07665474		
Total	64	5.328086613			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.316956489	0.085829296	3.692870646	0.000470479	0.14538636	0.488526618	0.14538636	0.488526618
LR	0.276778237	0.129119537	2.143581391	0.035996857	0.018672245	0.534884228	0.018672245	0.534884228
RE	0.094138887	0.071647897	1.313909985	0.193717413	-0.04908306	0.237360833	-0.04908306	0.237360833

Regression Output: Net IRR Ranking on Gross IRR Ranking

Independent Variable: Ranking Based on Gross IRR - Managers with 2 or more Funds
Dependent Variable: Ranking Based on Net IRR

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.923600037
R Square	0.853037028
Adjusted R Square	0.850810316
Standard Error	0.116566699
Observations	68

NR = 0.040 + 0.919GR

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	5.205385359	5.205385359	383.0927142	3.48183E-29
Residual	66	0.896794486	0.013587795		
Total	67	6.102179845			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.04037046	0.026952178	1.497855213	0.138938567	-0.01344128	0.0941822	-0.01344128	0.0941822
Gross	0.918618658	0.04693354	19.57275438	3.48183E-29	0.824912855	1.012324461	0.824912855	1.012324461

Independent Variable: Ranking Based on Gross IRR
Dependent Variable: Ranking Based on Net IRR

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.948433664
R Square	0.899526416
Adjusted R Square	0.898596105
Standard Error	0.100595614
Observations	110

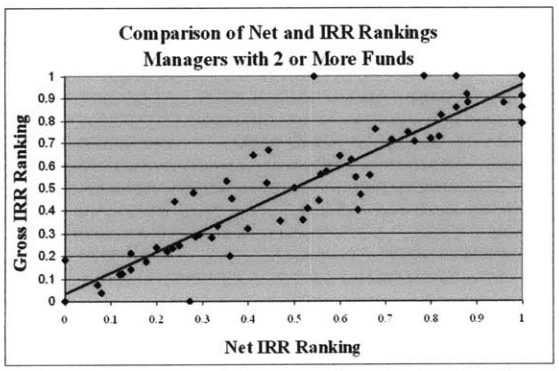
NR = 0.026 + 0.948GR

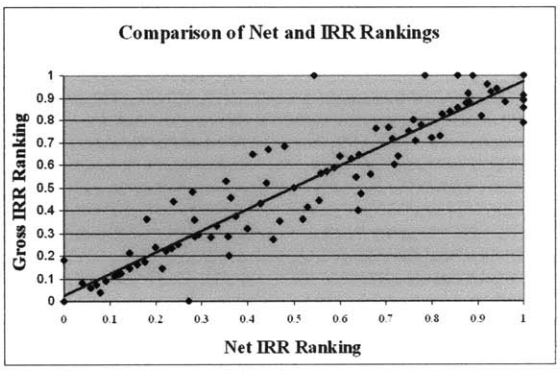
ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	9.784617993	9.784617993	966.909397	1.04131E-55
Residual	108	1.092903582	0.010119478		
Total	109	10.87752157			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.025783168	0.018015909	1.431133296	0.155279322	-0.009927444	0.06149378	-0.009927444	0.06149378
Gross	0.948433664	0.030500999	31.09516678	1.04131E-55	0.88797547	1.008891859	0.88797547	1.008891859

Scatterplot: Net IRR Ranking on Gross IRR Ranking





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